# SCIENCE

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## LEATHER LINK BELTING.

THE first impression on seeing a piece of linked belting such as we show illustrations of in this week's *Science* is that the inventor has gone far astray to make a complicated arrangement to take the place of the simple band of leather we are all so familiar with as used in transmitting power. It is only a few years since such belts were first introduced into this country, and till recently they have been looked on as more novel than useful. But as now made they are said to have proved their capabilities of doing all that the old solid belts would, and more. Their great flexibility is one of the strong points in their favor, as they can adjust themselves to almost any angle, so that they can be used in positions where the shafts are out of line with each other, and the belt needs to be twisted.

In the centre of the belt, as shown in Fig. 1, is a series of twisted links. These enable the belt to bend transversely, so that it can adjust itself to the rounded face of a pulley. Figs. 2 and 3 show the contacts of the older form of linked belting, and of that with this so-called American joint, on a curved faced pulley.

The last illustration given (Fig. 4) shows the belting as used in driving a dynamo, the slack side of the belt being on top. In this way the amount of contact with the pulleys is considerably increased and the slip correspondingly diminished. At one time it was supposed that this new belting would give the best results with slow-running machinery; but the actual tests, it is claimed, show it to be well adapted to the fast work called for in driving dynamos.

It will be readily seen that the making of an endless belt is a matter of passing rivets through the links at the point of union, and that such a belt can be made longer or shorter with but little difficulty.

It has thus resulted that a most eccentric invention has apparently found its place among those that make modern machinery more effective.

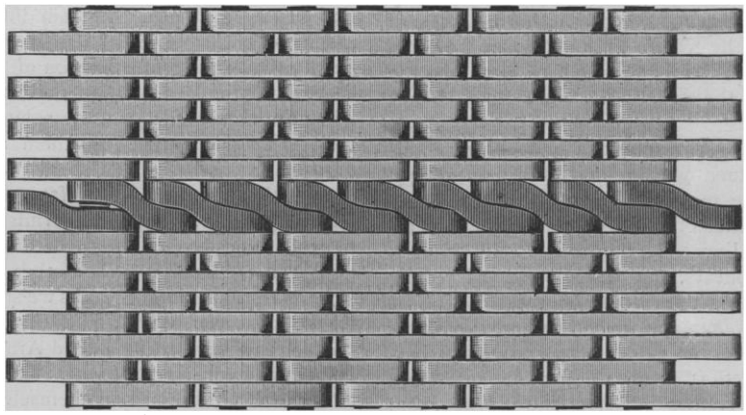

FIG. 1.

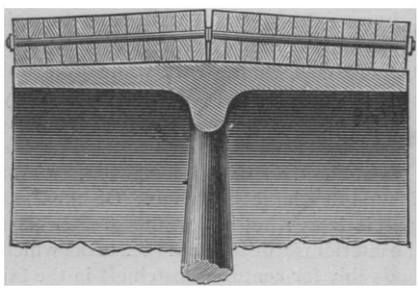

FIG. 2.

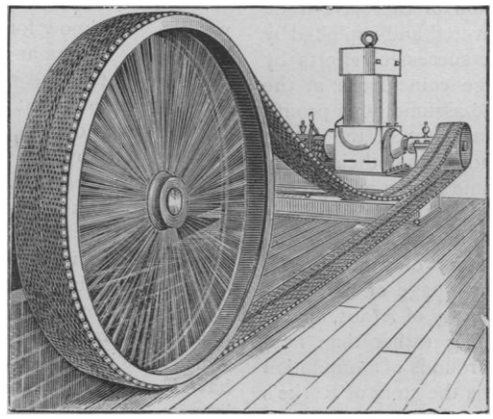

FIG. 4.

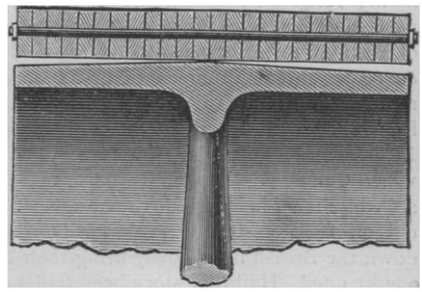

FIG. 3.

LINKED LEATHER BELTING.

## NYASSA-LAND AND ITS COMMERCIAL POSSIBILITIES.[1]

THE rapidity with which the geography of Africa — the New World of the nineteenth century — has been opened up to the knowledge of Western civilization during the last forty years, has left very little to be filled in on our charts of the Dark Continent. As a natural sequence to the delineation of the strictly geographic features of the country comes the desire to know something of its climate, products, inhabitants, and resources. Added to the ever-increasing pressure caused by the increase in population, is that love of adventure which marks us as a nation, and leads the upper classes to speculate in travel, and the lower in emigration. Is Africa a suitable field for immigration? Does its vast area produce such articles as European civilization requires? Will its peoples and tribes buy our calicoes and manufactures, and have they any thing to offer us in return? These are the questions which have usurped the place of the vague wonder as to what lay in the unknown interior. We are concerned only with one comparatively small portion of this vast continent; and we deprecate criticism, *ab initio*, by saying that even of this portion we must speak largely by inference, analogy, and report.

By "Nyassa-Land" we include that country discovered by Livingstone, and the scene of his last wanderings and death. Roughly speaking, it is bounded on the north by the southern shores of Tanganyika and the borders of the Kongo Free State; on the west, by Lakes Bangweolo and Moero, and the Kongo Free State; on the south, by the Zambezi; and on the east, by the Shiré River, Lakes Shirwa, Nyassa, and Leopold.

Nyassa-Land has during the last year and a half come prominently into notice. Certain influential exponents of British thought and feeling have taken up once more the question of the slave-trade. The consensus of evidence of men so different in character and thought as Livingstone, Lavigerie, Cameron, Elton, Stanley, and Johnston, is not to be gainsaid, and British national feeling has once more proved itself on the side of the oppressed. It was generally agreed that Nyassa was one of the centres of the slave-trade. It had been, moreover, for many years the sphere of perhaps the strongest missionary effort in all Central Africa. Here for over twenty years the Universities' Mission had worked, and spent many thousands of pounds and many noble lives. Here for the last fourteen years the Scotch churches had been working with untiring zeal, founding some dozen stations; and closely following on these a trading company, in its origin largely philanthropic, and founded at first as a lay mission society, had established trading-centres along all the area occupied by the missions; while even private philanthropy had expended large sums in the construction of the "Stevenson" road, between Tanganyika and Nyassa. No wonder that those interested in the suppression of the slave-trade turned their attention to Nyassa-Land, discovered and exploited by British, and the centre of so many and such successful efforts by our countrymen for its good. By a strange coincidence, at the moment that the question of Nyassa began to assume such prominence as a centre of the slave-trade, and on account of the action of Portugal towards our missionaries and traders, and their hardly concealed threats of annexation, — at this same time a new prominence was given to the country by the news that the slave-traders had attacked one of the trading-stations on the lake, and that the British were fighting for their lives. The history of that siege, of which Consul O'Neill was the hero, reads like a page of fiction, — six white men, holding their own against an army of Arabs, utterly cut off from assistance, voluntarily remaining rather than haul down the British flag, slowly firing their last rounds of ammunition one by one! Had that story been told as was the story of Rorke's Drift, England would be aware that she had six new heroes.

It is our firm belief, that, for a country to be developed and civilized, any scheme set on foot must have a sound commercial and practical basis. This is the keynote of Sir John Kirk's creed, than whom no man has been more practically successful in Africa.

What, then, are the inducements offering for commercial enterprise in Nyassa-Land? Let us first view it from the standpoint we have already taken, the development of what has been already initiated in the past. The carrying-trade for the missions alone is sufficient, in our opinion, to pay dividends to a small company. Undoubtedly the route to Central Africa, the quickest, far the cheapest, the easiest, and healthiest, is by the waterway of the Zambezi, Shiré, and Nyassa, to Tanganyika. All the necessary supplies for the missions along this route, together with calico for their payments, should pass through the hands of the company on Nyassa, including the supplies of food and calico for those settled immediately around Tanganyika, both in the Kongo Free State on the west, and the numerous Arab settlements on the east; for around each mission station there grows up rapidly a desire for some of the rudimentary necessities of civilization. The ideas of decency and of cleanliness are encouraged by mission settlements, and thus the two first wants of calico and soap are rapidly developed. These, together with salt, a chronic savage want, and metal wire and beads for personal adornment, are essentially the pioneering elements, and indeed constitute the money of the country, for which the natives are willing not only to bring their produce, but to work by the week or month. These things, too, are largely required by the Arabs, and to a less degree by their followers; and, as they can be imported to the north of Nyassa at just about half the price which the Arabs can bring them for, a large trade might be done with these people, who are keen traders, and only too ready to see on which side their interest lies; while, if such commodities were supplied to them at the lowest prices compatible with small profit, the great extension of our trade would amply, we believe, cover the loss consequent on the reduction of present prices, while the prosecution of trade relations would tend to bring about a closer connection between them and the white men, and so to disarm the present feeling of mistrust and hostility. In return for these articles, we should get from the native chiefs (1) the entrée into the country, with ready permission to settle near them and so to exploit and develop the mineral wealth of the country; (2) in actual payment, ivory and such other local products as we shall speak of hereafter. From the Arabs we should get (1) we hope toleration, for we must ever bear in mind that at starting we should be utterly unable to cope with the united Arab power in these regions; (2) in actual payment, ivory, of which the Arabs are by far the best collectors. From the people themselves we shall get manual labor, porters for transport, and some minor products. The two former are the great desideratum for exploiting the country or working its minerals.

In this way the existence of the missions is a direct encouragement to trade. We have said that there is a constantly growing demand for calico and other trade goods. Let us as briefly as possible see what the country has to give us in return. One thing only, in our opinion, will pay for the initial expense of exploitation and the subsequent heavy transit expenses, and that is mineral wealth. We know for certain now that gold exists close to the lake shore. Years and years ago, alluvial gold, and also copper, were brought by the natives from Katanga. There is very good reason to believe that the gold-bearing quartz reefs south of the Zambezi extend probably from south-west to north-east through this district, towards Moero and Katanga. Asbestos has been found on the north-west shore, coal on the east, while iron and copper are worked by the natives themselves. We have, then, very fair grounds for believing that this country will repay by its mineral wealth the initial cost of exploitation. Its other products are in a sense valuable, but would not, in our own opinion, ever of themselves alone pay dividends to a large company. Of these, at present, the most important is ivory; but by far the greater part which finds its way from the interior is "dead ivory," i.e., tusks which have been kept for years, possibly for centuries, by chiefs in the far interior, who were ignorant of its value, and used it as ornamental door-posts, etc., and who now part with it to the Arab traders who have penetrated to their lands, in exchange for trade goods. This is, *ipso facto*, a decreasing product; and no less so, we think, is the "green" or newly killed ivory. Where only a year before large herds of elephants were to be met with daily, the writer has wearily followed tracks day by day without seeing a single elephant. The importation of guns and powder is responsible for this sad destruction. Native hunters shoot down remorselessly, not merely cows, but calves of any age, content to slaughter the latter to gorge on their flesh, if they have no tusks to extract; while the unfortunate

[1] Paper read by Capt. F. D. Lugard of the English Army, before the British Association at its recent meeting.

fact that the African cow-elephant carries tusks renders her, even in the eyes of European sportsmen, a legitimate prey, and the enhanced value of cow-ivory compensates for the lesser weight of her tusks as compared with the bull. Once more we would urge that the utmost endeavor be made to check this reckless slaughter. The writer has had charge of close on sixty government elephants in India for some considerable time, and again in Burmah, and may therefore claim, perhaps, to speak from some personal experience of the great services this animal, when domesticated, is capable of rendering. In a country where the horse, the ass, and the bullock — the two former imported at almost prohibitive expense — are all subject to destruction by the tsetse-fly, as well as the numerous diseases peculiar to a tropical country, the elephant, if domesticated, would be simply invaluable as a transport animal.

Second only, indeed, to the discovery of a payable export, is an efficient means of transport, to replace the slave-labor of the Arabs, and the expensive and unsatisfactory porterage which the white man has at present to employ. Of other products which, after development, would form payable exports, the most important is perhaps coffee. The coffee-shrub is, we believe, indigenous on the Zambezi. On the Shirê highlands it has been cultivated with the greatest success by Messrs. Buchanan at Lomba, the Lakes Company at Mandala, and the Mission at Blantyre. At these places very large areas are now planted with fine healthy coffee-shrubs, bearing well. Tea, we believe, has been lately experimented with, but so far we are unable to say with what result, though from the analogy of India we should predict a success. Cloves and cinchona-bark should also do well. All these, being of small bulk in comparison to their value, should be lucrative articles of export, and should grow equally well on the highlands between Nyassa and Tanganyika on the north, and Bangweolo and Moero on the west. From the lowlands we may add rubber as a payable export. Several kinds of rubber-vine grow profusely at the north of the lake. At present this trade is completely untouched.

In addition to these primary products, which need time for their development, there are a large number of minor ones, which, though we think that they would not in themselves offer adequate returns for money invested, would nevertheless materially lessen the initial expenses. The conveyance of European supplies, porters, arms and ammunition, building and other material to the north of the lake (at which place we would advocate a considerable depot), together with the ordinary mission carrying-trade, will necessitate the steamers going northwards with full cargoes. On their return journeys they could be loaded with some of the secondary, less valuable, and more bulky products which we are about to enumerate.

But, in our opinion, most of these are more valuable for local use and manufacture than for export, and by means of such an application of indigenous products the cost of stations in the interior might be largely reduced by the reduction of European supplies at present necessarily imported. A favorable instance of such is the Misanguti tree. This most picturesque of trees produces an incredible number of fig-shaped fruit-pods, each of which contains from four to six scarlet beans, and each bean is saturated with oil. They are used by the natives for food; and the oil, too, is extracted by boiling. When cool, this oil or fat is solid, even at a tolerably high temperature, and has the appearance of beeswax. It burns well as a night-light, and, mixed with beeswax (an easily obtainable local product), would have sufficient consistency to make candles, and thus save one article of present import. We believe, also, that it would make excellent soap; and it is not expecting much to assume that the potash and alkalies for this manufacture could be locally found. A certain quantity, indeed, could be obtained from the large quantities of wood-ash produced by the steamer-fuel. This would not only save the import of soap for consumption, but might even supply one of the staple articles of barter. The Misanguti, moreover, supplies from its bark a capital mahogany dye; and from the fact that the natives use it to dye their fishing-nets, and from the oily properties of the tree, it is presumable that it has very highly preservative properties. The wood of this tree is hard and valuable, and, as far as we could judge, its presence and shade were not injurious to vegetation, so that it might be largely cultivated in areas devoted to cereal crops. Lastly, we would suggest the experiment of an oil-cake made from its beans as a food for cattle and asses.

Another product of the country, at present almost wholly neglected, is hides. The Wa-Mambwa, Wa-nkande, and Angoni tribes possess enormous herds of cattle, and, except for the making of war-shields, the hides of these are little used. The hides of the buffalo, of which there are thousands in the plains at the north of the lake, being too heavy for this purpose, are entirely wasted. The great bulk of raw hides prohibits their export on the present small steamer, and would at any time be a serious detraction from their value as an export at such a distance from the coast. To obviate this, we would advocate the formation of crude tanning-pits, with the object of removing such portions as are unnecessary, and of softening the hides sufficiently to make them packable into a smaller bulk. One of the commonest trees in that district is the thorny acacia, called in India the Babul, in which country its roots and bark are largely used for tanning purposes. The forest, too, abounds with astringent fruits and berries; such as the Owlah (dear to sportsmen), and others of whose names we are ignorant. The collection and preparation of these hides would afford employment to those in inland stations; and these semi-tanned hides would largely assist in meeting local necessaries, such as camp-beds, tenting, or taking, in fact, to some extent, the place of waterproof sheeting. There are, moreover, many kinds of oil-seeds (such as the ground-nuts, etc.) and of dyes which would supply the return cargo for steamers. Of other European necessities, sugar is already manufactured at Lomba by Messrs. Buchanan, and its quality is improving yearly. Wheat, linseed, flax, cotton, and perhaps indigo, we think, could be grown on the highlands, and a fair substitute can be made for wheat-flour from the local grains. Of tea and coffee we have already spoken. Opium has been successfully cultivated at Mopea on the Kwakwa for many years, and under Mr. Addison's energetic management and improved methods the company has lately renewed its vitality. Butter and cheese can be made for local consumption in the cattle-producing districts. At present these European necessities are imported. Another valuable secondary product is fibre. From the coir fibre of the Borassus palm, to the soft down of the cotton-tree, the land produces endless fibre.

Acres, nay forests, of plantain surround every Nkonde village, and the plantain fibre rots on the ground. From this, and from the bark of various trees, the natives are very clever at making rope of every size, from twine to a cable, which they call *matusi*; but being prepared green, and without the fibre being properly separated and interwoven, it becomes brittle when dry, and does not last long. They make also baskets and very superior mats of plantain-fibre. There is, however, a species of hemp which grows very freely, and of which I am informed the fibre is singularly tough, which might form a valuable article of export in the form of tow. Doubtless investigation may bring to light many valuable drugs (the *Strophanthos* proved an El Dorado till the market was glutted); while among the many lovely plants (the wild gladioli and other bulbs, the gardenia-like flowering shrubs, the tree orchids and the ferns) many species may command a sale in the British market, and help to make capital, while the more extended schemes which are to produce the dividends of the future are being developed.

The timber on the highlands is small and of no great value; but in the lowlands there are several kinds of valuable timber-trees indigenous to the country, while ebony and other ornamental woods are, we believe, found on the Shiré. Many kinds of imported trees thrive excellently both on the highlands and at the level of the lake. Of these, the mango is doing well at Bandawe, and has grown for very many years on the Zambezi, imported by the Portuguese Jesuits: it is valuable both for its fruit and timber. The Neem, valuable for its oil and the medicinal properties of its bitter leaves, the blue gum and other eucalypti, the Gold Mohur tree, orange, lemon, and loquotz, also grow well, and prove that other trees growing in the same latitude and at the same altitude as those do in India would also thrive in Africa. Of such, the two great timber-trees, the teak and the Sal, would be worth introduction, as also the useful Mohwa tree; while, by the analogy of India, the oak and other timber-trees of England should do well on the higher plateaus.

In conclusion we will endeavor to answer the question as to the suitability of the country for immigration. The Shiré highlands, with their cold, bracing air, have proved by the test of many years to be well adapted to the conditions of European life. Scotch and English ladies have lived there in excellent health, and their children are robust and healthy. If this be so, we think that the still higher plateaus farther inland should prove healthy, and capable of producing the vegetables and other minor necessities of European life. But to attain these highlands, the malarious coast district must be passed through, and the graves of many ladies in this area prove its deadly influence. The first requisite, therefore, is a means of rapid conveyance from the coast, together with more fully developed means of accommodation and comfort. The opening-up of the navigation of the Zambezi from its mouth, thus establishing a direct communication with the sea-going steamers, would largely effect this, and the new steamer of the Lakes Company now put on the river leaves nothing to be desired for comfort. Enthusiasts may even picture the time when the railway — already projected — from the Cape shall be extended from Kimberley to the Zambezi, and so the malarious coast district be avoided altogether. But even the coast area itself has long been peopled by British Indian settlers, who have penetrated the whole length of the Kwakwa. The shores of the lake would be admirably suited for Indian immigration. We would, however, urge that such immigrants be drawn for northern India.

Nyassa-Land is a country, as Lord Salisbury recently said, discovered by British, opened up and to some extent civilized by us, and its possibilities we honestly believe to be great. Its climate is for the most part good, its scenery picturesque and enchanting. The time has come for its development and gradual civilization, and Britain must decide now or never, whether this opportunity is to be ours, or whether this land — historical in its past associations with the names of Livingstone and his many successors, and full of promise for the future — is to be ours, or to be left to the Arab slave-dealer for the present, and the fortuitous exploitation of some European nation in the further future.

## HEALTH MATTERS.

### Immunity and Immunization.

Dr. H. Buchner has recently published a new study of this subject, and *The Sanitarium* gives the following *résumé* of it: Immunity in its full meaning signifies a condition of the body which permanently opposes the development of infectious processes; but there are conditions which act transiently in the same way against the danger of infection already existing. Buchner exemplifies this by a person attacked with typhus. In this case the disease, the continuous multiplication of bacilli, is not terminated before all tissues acquire transient immunity against the fungi. But what are the means by which the organism acquires immunity in a permanent or transitory way? To answer this question, Buchner first refers to Pasteur's protective inoculation, the actual efficiency of which is generally admitted at the present time. Buchner calls it a great triumph that it should be possible to immunize a living organism in this way without hurting its tissues.

Again, another means of immunization comes from France. Chamberland and Roux have injected intra-peritoneally the chemical substances of bacteria (ptomainia) in experiments on animals affected with malign œdema and with anthrax, without taking the bacteria themselves. The animals were actually rendered resistant to inoculation with living bacilli of the corresponding disease. This discovery is practically very important, inasmuch as the effects of chemical agents for the purpose of immunization are certainly more accurately measurable than those of living fungi. Theoretically the discoverers neglected drawing the necessary consequences from their results, and this has been done by Buchner with zealous energy. He prefaces his developments with a discussion of the means by which transitory immunity may be obtained. It might be possible to neutralize specific ptomaines in the organism by means of certain substances, just as Behring succeeded in decomposing the ptomaine of cholera-vibrios, cadaverine, by means of iodoform. Nature uses inflammation as an antidote against the invasion of fungi. Ten years ago Buchner pointed to this re-action of the organism by which it acquires transient immunity, but at the present day he disposes of proofs for his hypothesis. In a former paper, Buchner has described anthracic pneumonia produced by the inhalation of anthrax bacilli. Its symptoms are those of a sero-fibrinous hemorrhagic pneumonia. In the alveoli there is found an exudation abounding in cellules and an immense quantity of anthrax bacilli. On the other hand, the pulmonary capillaries and the larger vessels were absolutely devoid of bacilli, the spleen containing only a very few of them.

For the purpose of investigating the modus by which the agents of infection are arrested in their further invasion, Buchner has lately instituted some experiments, which led to the conclusion that "inflammatory re-action not only possesses the power of arresting the passage of bacteria through the pulmonary surface, but actually to cause degeneration of the infectious bacteria, and consequent destruction." It is not permitted here to give in detail the interesting experiments which Buchner, jointly with Dr. Schickhardt, has performed on animals infected with anthrax bacilli. The microscopical result confirmed Buchner's hypothesis that inflammation originates in consequence of the bacillus, but that conversely, once originated, it induces degeneration in the bacillus, and may doubtless cause its complete decay. The latter hypothesis is corroborated by the shapeless agglomerations of granules which are found, and which represent a transformation of the bacilli.

In accordance with the fact of an antibacterial, immunizing action of inflammation, Ribbert and Lahr have ascertained, after injecting staphylococcus avoreus into the trachea, that the local inflammation prevents the bacteria from penetrating into the organism, and subsequently causes them to degenerate and to die. Emmerich, and similarly Paulowski, have tried already to utilize these experiences in a practical way, — the former by his experiments with injection of erysipelas cocci in animals affected with anthrax, the latter by establishing the fact that even simple saprophytic fungi have a restraining curative influence on simultaneous anthracic infection. It may be possible in some other way, as tried already by Landerer by means of Peruvian balsam, to create in the organism a condition of excitation which might be used as a means of immunization. Through what kind of chemical and microscopical conditions an inflammatory excitation, or immunity acquired by protective inoculation, may act deleteriously on the bearers of infection, is explained on the results of Metschnikoff's well-known phagocytic theory. In Buchner's opinion, this theory constitutes one of the greatest additions to our morphological and physiological science of infectious processes.

Metschnikoff's doctrine, opposed from many sides, draws its principal importance from the fact of having demonstrated that viable, pathogenic bacteria may indeed be devoured by cellular elements. It explains how leucocystic and other cellular elements migrate into certain tissues in a condition of inflammatory excitation, and, exposed to infection, there display their phagocytic action. It is true, Buchner does not consider every thing explained by this process alone. On the contrary, a certain chemical reaction and concentration of the different tissue-fluids seems to be necessary for the debilitation and destruction of the fungi. Buchner, on the ground of experiment, is inclined to suppose the existence of fluid substances which, formed by the febrile process, have an antibacterial action.

This explanation being quite satisfactory for transient immunity, there are other processes to be considered in permanent immunity. Voit's experiments in Buchner's laboratory have recently furnished the proof that the organism possesses in the living blood-plasma chemical properties of this kind, deleterious for bacteria. Living blood, generally, is an unfit alimentary substratum, but by a change of its quality it may become a proper medium, and in this case a morbid affection of the organism would take place; the period of incubation would then be the time in which the blood is still possessed of those properties which arrest the bacteria in their growth, or possibly even destroy them. Immunity, then, would represent a permanent power of the organism to maintain the period of incubation. The question, in what way transition to actual morbidity is prevented, is answered by Buchner, availing himself of the experimental results obtained by Chamberland and Roux, by the suggestion that it is the adaptation of the organism to the spe-

cific virus which makes the latter gradually lose its pathogenic properties. This very supposition of adaptation underlies protective inoculation with attenuated specific fungi, as well as with dissolved specific products of decomposition.

INOCULATION AGAINST INFLAMMATION OF THE LUNGS IN CATTLE. — At the end of last year the Prussian minister of agriculture ordered experiments to be made on cattle, in order to decide the extremely important question whether inoculation affords protection against infectious inflammation of the lungs in cattle or not. These experiments, according to the *Lancet*, were carried out under the superintendence of Professor Schütz and the departmental veterinary surgeon Steffen, in the government district of Magdeburg, and have recently been finished. On Oct. 8 last, twelve young bulls were inoculated with fluid and particles from diseased lungs, — three with warm and three with cold fluid, three with warm and three with cold particles. Those inoculated with warm fluid contracted the disease most severely. On Oct. 26 all twelve, along with four uninoculated animals of the same age and breed, were placed among cattle suffering from infectious inflammation of the lungs, and their noses were repeatedly brought into the closest contact with those of the diseased animals for hours together. In December and in January all the animals were killed, and the post-mortem showed that the twelve inoculated animals had remained healthy, and that three of the four uninoculated ones had contracted the disease. The experiments were now repeated, special care being taken that all the animals (inoculated and uninoculated) were exposed to as nearly as possible equal degrees of infection, and that the fluid used for inoculation was taken warm from the lungs which had proved most effective. On Nov. 9 twelve young bulls were inoculated with different quantities (0.05 to 1.0 cubic centimetre) of warm lymph. The quantity of the fluid used did not affect the intensity of the local process. One bull died on the thirty-fifth day after inoculation, of peritonitis, caused by the spread of the inoculation process. On Dec. 1 the inoculated bulls were placed among bulls suffering from infectious inflammation of the lungs, but did not contract the disease. On Jan. 27 they were taken to another stall, and again placed among bulls suffering from the disease in question. On April 12 the eleven inoculated and two uninoculated bulls were inoculated with warm lymph between the neck and the breast, after which the two latter became severely ill, and one of them died. The previously inoculated animals, on the other hand, showed only slight symptoms at the place of inoculation. On April 12, twenty grams of warm lymph were mixed with 2,000 of warm sterilized flesh-broth, and sprayed before the nostrils of the inoculated animals. They remained healthy. On May 13 they were again placed among others which were suffering severely from the disease in question. After this, no morbid symptoms were observed in them. On June 26 one cubic centimetre of warm lymph was injected into the lungs of each of the inoculated and of two uninoculated bulls. The inoculated animals remained healthy, while the two uninoculated ones contracted the disease in a very severe form, and one of them died. At the end of July the inoculated animals were killed and dissected, and no abnormal developments were found. It therefore now seems to be proved that cattle inoculated with fresh warm lymph are protected against infectious inflammation of the lungs.

THE HEARING OF SCHOOL-CHILDREN. — Over nine thousand children have been examined in the schools of the following cities, — New York, Stuttgart, Bordeaux, Munich, and Glasgow, — and the average of defectively hearing pupils is 26 per cent plus. As a comparison test between children who were regarded as bright and those considered backward and dull scholars, teachers were requested to make a selection of seventy of each group. The results of the examination of the two sets, says the *British Medical Journal*, show twice as many with defective hearing among backward children as among the forward children. Some of the advice given to teachers would be, keep in mind the liability of existing impairment of hearing in the backward children. Children known to be suffering from defective hearing should be given seats nearer the teachers, and with their best ear towards the desk. When the defect is considerable or extreme, they should be taught in separate classes. All boxing of the ears of children should be stringently prohibited.

CONFECTIONERS' DISEASE. — A disease peculiar to confectioners has been recently observed in France. It occurs principally in persons engaged in the manufacture of candied fruits and *maron glacés* or candied chestnuts. Five cases observed by Dr. Albertin of Lyons, described in the *Gazette Hebdomadaire*, March 19, 1889, well illustrate the nature of the disease. The affection is restricted to the nails of the hands, and usually first makes its appearance at the sides of the nails, the periungual portion becoming loosened and raised up, the nail losing its polish and becoming black. In more advanced cases an inflamed swelling appears at the base of the nail. The nail is rough, scaly, and in some cases broken in several fragments, but is never cast off in its entirety. Finally the terminal phalanx also undergoes a change in form, and becomes flat and widened. In the earlier forms of the disease very little pain is experienced, and the patient is able to go on with his work. The disease disappears as soon as the work is discontinued, although a deformed nail and a flat or bent terminal phalanx are apt to remain. Albertin states that among the large number of candy-factories which he has visited, he has not found one in which from one to three workmen were not suffering with the disease. *The Medical and Surgical Reporter* suggests that the affection is caused by handling and working in the various substances employed in the manufacture of candies, among which are mallic, tartaric, and citric acids. The hands are also alternately in cold and hot liquids; and this, as well as the manipulation of the preparations, by means of which the irritating substances find their way under the nails, may be regarded as causative factors. It would be interesting to know whether this disease exists in this country, where the manufacture of candies is so extensive.

CURIOUS TRANSMISSION OF SCARLET-FEVER. — The *Boston Post* is responsible for the story that in 1846 a boy eight years old was taken down with scarlet-fever, and died. One of the principal amusements of his illness had been looking over a large picture-book. After his death, this, with several other useful playthings, was packed away in a trunk. Twenty-six years later, in 1872, the trunk was taken to England. The trunk was opened the second day after its arrival, and the picture-book was taken out and presented to a boy two years old. During the next fortnight the little fellow was attacked with scarlet-fever. It was a wonder to the doctors who were called in consultation how the disease had been contracted, as there had been no scarlet-fever in the town for years. At last it was suggested that the picture-book might have transmitted the disease; and the medical men in attendance, on being told the facts connected with it, agreed that it had retained the poison for twenty-six years, and then communicated it to the child. This appears, says *The Medical and Surgical Reporter*, to be one of the instances in which scarlet-fever from some unknown source developed coincidently with the handling of articles used by a patient who had the disease many years before.

## MENTAL SCIENCE.

### Mental Activity in Relation to Pulse and Respiration.

THAT the blood circulation in the brain is an important factor in its healthy activity, and that the intermittent supply of the same recorded by the pulse, and the intermittent purification of the blood by the lungs in breathing, must also play important parts in the maintenance of mental action, are admitted by all physiologists, though our knowledge of the precise nature of these influences is very limited. Professor Leumann of Strassburg (*Philosophische Studien*, v. No. 4) calls attention to the necessity of noting the pulse and respiration rates in psychological experiments; and, though he gives but few positive results, his treatment of the topic is highly suggestive.

Such general observations as that when out of breath, owing to running or severe exertion, not only articulation but the words themselves fail one; that in drowsiness or sleep both pulse and respiration are slackened, — indicate the connections of the two functions. Again, these rhythms make themselves felt in such ac-

tions as dancing, scanning, and even the fluctuations of sensation. For example: a star just visible to the eye fades away and reappears. The intervals of this attention wave have been measured, and, according to one observer, are from 2.5 to 3 seconds for sensations of electrical shock, 3 to 3.4 seconds for light sensations, and 3.5 to 4 seconds for sensations of hearing; or 24 to 20, 20 to 18, and 17 to 15 fluctuations per minute, — a rate strikingly similar to the rate of breathing. It would be interesting to find whether these sensation "waves" vary essentially in persons with abnormally high or low respiration rates. Again, the relation of the rate of scanning to pulse and respiration may be tested. One subject, when his pulse tells 77 per minute, reads 113 feet per minute, but, with a pulse of 83, reads 140. Individual differences in pulse and respiration may affect the normal rate of reading. One subject, with a pulse of 86 and a respiration of 26 per minute, makes 55 double steps, and reads 126 trochaic feet, in a minute; while another, with a pulse of 66 and a respiration of 22, makes 51 steps and reads 120 feet in the same time. Verse-reading in schools might be similarly tested. In a preliminary test a pupil with a pulse of 85 read 107 feet per minute, another with a pulse of 98 read 129.

In one case Professor Leumann made a distinct test, measuring the pulse at frequent intervals, and also the rate of scannings as the subject was reading. Comparing the rates before an intermission with those after, he finds an almost exact correspondence of scanning rapidity with pulse rate. When 40.1 feet are read per minute, the pulse is 85⅜; when 38.8 feet are read, the pulse is 82⅛.

It is noteworthy, too, that a large range of association times varies between .7 and .8 of a second, — the period of a normal pulse-beat. In reproducing time intervals, the period reproduced with least error is also this same period. These, however, are mere suggestions. The outcome of the paper is to accentuate the importance of noting these physiological conditions when studying psychic phenomena, and particularly when making time measurements of them.

DISTANCE AND SIZE. — One of the most vexed questions of psychological optics relates to the inference of distance when the size of an object is known, or the inference of size when the distance is known. Psychologists are agreed that the process is not immediately given in sensation, but the result of experience. The young infant reaches for things entirely beyond its grasp. Under ordinary circumstances, our inferences of size, though unconsciously performed, are extremely complicated. The estimation of half a dozen different kinds of perspective, together with what real knowledge we have of the sizes of the objects in question, enters into the result. To study the question scientifically, we must arrange the observation so as to exclude all but a single variable. When this can be done, as, for example, in the gradual removal of an object from the eye, under proper conditions, the general assumption has been that the result depends on the size of the retinal image, or by the angle made at the centre of the eye by the extreme contours of the object. In the last number of the *Philosophische Studien* (vol. v. No. 4), Dr. Götz Martius describes a few experiments that lead him to question the correctness of this view. At a constant distance of 50 centimetres from the eye of the observer he placed a rod 20, 50, or 100 centimetres long. At a much greater distance (either 2½ or 5¼ metres) he had a variety of rods, differing from one another slightly in length only. Both were viewed against a continuous and uniform brown background, and the problem of the observer was to judge when the distant rod seemed equal in size to the near one. Even here the fact that we are accustomed to interpret the far in terms of the near, and pay attention only to estimating the actual size of the object, makes it difficult to separate judgment and impression; to answer, not whether, if the distant rod were brought side by side with the near one, it would be equal to it in length, but whether the retinal impressions of the two as they are seem the same. After a little practice, this can be done, though the result does not point to a definite length, but to a narrow range of lengths any one of which seems equal to the near rod. Taking the average values, one observer, with 5.25 metres between the two rods, judges the distant rods of 21.67 centimetres, of 57.62 centimetres, and of 106.62 centimetres to be equal to near rods of 20, 50, and 100 centimetres: at 2.50 metres between the rods, the former lengths become 20.62 centimetres, 53.87 centimetres, and 107.75 centimetres. Similar results for Dr. Martius are 21.92 centimetres, 59 centimetres, 110 centimetres, and 21.62 centimetres, 56.62 centimetres, and 109.25 centimetres. What these figures show, apart from the facts that such observations are possible and that the result varies with the individual, is that a distant object, to seem equal to a near one, increases in size with the distance, but increases very slowly; much slower, that is, than the visual angle decreases. It is probable, too, at the same difference of distance, the ratio between near and distant objects of various sizes remains constant. The result requires further corroboration and extension, but, even as it is, is important in rendering improbable the usual view of the matter.

SENSIBILITY TO TONE INTERVALS. — The ear has been called the mathematical sense, because the perception of musical interval involves the nicest appreciation of definite numerical relations between the vibration rates of the tones forming the interval. The very slight deviations from a true interval recognized as such by skilled musicians, which Helmholtz has satisfactorily explained as due to the relations of the overtones of the two tones, shows us that the interval sensibility must be very fine. The accurate determination of this sensibility for the various intervals has been attempted by a few methods, but with results individually different, and containing sources of error. The whole topic has been rigorously re-investigated by Iwan Schischmánow in the psychological laboratory at Leipzig (*Philosophische Studien*, v. No. 4). The method consisted in adjusting a movable weight on a tuning-fork until (1) it just formed a certain interval with a constant fork, (2) it just appreciably diverged from it above, and (3) just appreciably diverged from it below. The results are then grouped, and an average formed, expressing in fractions of a vibration per second the difference between the vibration rate of the true interval and the tone just distinguishable as not a true interval. For two observers, S and K, of whom S is a good amateur musician and K is not musical, the results thus expressed were as follows: for the octave whose ratio is 2 : 1, S 0.220, K 0.356; the fifth (ratio 3 : 2), S 0.332, K 0.374; the fourth (ratio 4 : 3), S 0.419, K 0.403; the third (ratio 5 : 4), S 0.485, K 0.559; major sixth (ratio 5 : 3), S 0.502, K 0.506; the second (ratio 9 : 8), S 0.548, K 0.716; minor third (ratio 6 : 5), S 0.607, K 0.640; minor sixth (ratio 8 : 5), S 0.672, K 0.740; minor seventh (ratio 9 : 5), S 0.678, K 0.763; major seventh (ratio 15 : 8), S 0.861, K 0.902. A comparison of these with former results leads to the conclusion that practise and individual traits contribute to the result, but that in general the order of delicacy of the various intervals as shown by S, especially the order of the four "best" and the "worst" perceived intervals, may be taken as fairly normal. This order corresponds nearly with that elaborated by Helmholtz on the basis of relative consonance of overtones, but it shows that perceptions of intervals are possible without such an aid. The numbers show, too, the great accuracy of the sense of musical interval. Another result is that the sensibility for the lowering of an interval is finer than for an increase of the interval, though it must be noted that the variable tone in these experiments was always lower than the constant tone.

## ELECTRICAL NEWS.

### Siemens's Five-Lead System.

THE municipal authorities of Königsberg, in Prussia, in conjunction with the representatives of the citizens, resolved this spring to carry out, at their own expense, an electric central station for the town, which was calculated for a supply of 30,000 16-candle glow-lamps, though arrangements are to be made at first for 8,000 lamps. The entire installation, as it is now about to be executed, merits the attention of the entire electro-technical world, and of all persons interested. A correspondent of the London *Electrical Review*, therefore, briefly gives the chief points which will be brought forward in executing the installation. The current will be supplied from four groups of slow-speed dynamos, arranged in series, and connected directly with the steam-engine. Between these dynamos and the conducting net there is placed a battery of

accumulators of suitable capacity and tension. For the net of conductors, in consequence of the extended line of streets to be traversed, the five-lead system has been selected. The leads are not cables, as has hitherto been customary, but uncovered rods of copper, resting on insulators of porcelain, and laid in channels of cement. These channels will be mostly carried underneath the flags of the footway. The distribution of the current takes place so that each of the four successive current circuits formed by the five-lead system shows a working tension of 110 volts. The execution of the entire electrical installation, original and in many respects interesting, is intrusted to the firm Naglo Brothers of Berlin, who will use for storing up electric energy "Tudor" accumulators made by the firm Müller & Einbeck of Hagen. The above-mentioned Siemens "five-lead system" has not yet been practically applied in any electrical installation; but the firm Siemens & Halske is executing two extensive installations on this system, — one at Vienna, and the other at Trient. These two installations will be shortly in operation, and as many doubts have been raised concerning the practicability of this system, which is a further development of the three-lead system, and is hence regarded as too complicated, the inauguration of the Siemens installations is awaited in technical circles with no little interest.

LENS IMAGES MADE VISIBLE BY ELECTRIC CURRENT. — In the *Photographisches Archiv*, Herr R. E. Liesegang, son of Dr. Liesegang of Dusseldorf, describes an apparatus with which it is possible to render lens images visible at an indefinite distance from the original object by means of the electric current. The instrument is based on the well-known principle that an electric current is produced by light-waves. If light strikes upon one or two platinum, silver, or copper plates, which are arranged in the form of a galvanic element, this gives rise to an electric current. If the exposed plate consists of a large number of insulated metal wires of small diameter, lying very closely together, and if some of these wires are exposed, others not, then, of course, the electric current is produced only in these exposed wires. If the wires are conducted to another analogously constructed plate, which may be placed at any distance from the first one, then the electric current will also here be produced only at the parts correspondent with the exposed wires of the first plate. By coating the second plate with any substance which by galvanic decomposition undergoes a visible change, exposed parts of the second plate can be easily distinguished from the unexposed ones. If, therefore, an image is projected by means of a lens upon the first plate, the same image will be obtained on the second plate.

AN ELECTRIC RADIATION METER. — At the meeting of the London Physical Society, Nov. 1, Mr. W. G. Gregory read a paper on "A New Electric Radiation Meter." He stated that the meter consists of a long fine platinum wire attached to a delicate magnifying spring of the Ayrton and Perry type, and stretched within a compound tube of brass and glass. At the junction between the wire and spring a small mirror is fixed. When the tube is placed parallel to a Hertz's oscillator in action, the mirror is turned in a direction indicating an extension of the wire. The arrangement is so sensitive that an elongation of $\frac{1}{200000}$ of a millimetre can be detected; and, when placed at the distance of a metre from the oscillator, the apparent extension is such as would correspond to a change of temperature of 0.003° C. By its aid the author has roughly verified Hertz's statements, that at considerable distances the intensity of radiation varies as the inverse distance; but, before he can proceed further, it is necessary to greatly increase the sensibility of the apparatus, and, with a view of obtaining some suggestions in this direction, he exhibited it before the society. Professor Perry asked if the electro-motive force required to produce the observed results had been calculated; he also believed that the sensibility might be increased by using copper instead of platinum, and replacing the spring by a twisted strip. Mr. Blakesley inquired whether the effect of increasing the capacity of the ends of the wire had been tried. Mr. Boys said, that, if the observed effect was due to rise of temperature, he would like to see it measured thermally. He also thought the effect might be due to extension caused by rapid electric oscillations in some such way as the elongation of an iron bar caused by magnetization. In answer to this, Professor S. P. Thompson said the matter had been investigated experimentally, but with negative results. Professor Herschel suggested the use of a compound spring such as is used in Breguet's metallic thermometers. In reply Mr. Gregory said that he had estimated the electro-motive force by observing that a Leclanché cell through 50 ohms produced about the same result. No improvement in sensitiveness was obtained by using copper wire or by increasing its capacity, and attempts to measure the rise of temperature by an air thermometer had been given up as hopeless.

DRIVING TUNING-FORKS ELECTRICALLY. — Mr. W. G. Gregory, at the meeting above mentioned, also read a paper on "A Method of Driving Tuning-Forks Electrically." In order to give the impulses about the middle of the stroke, the fork is arranged to make and break the primary circuit of a small transformer, the secondary circuit of which is completed through the electro-magnet actuating the fork. The prongs of the fork are magnetized and receive two impulses in each period. Another device was suggested, where the prongs respectively operate contacts which successively charge and discharge a condenser through the coils of the actuating magnet. Professor S. P. Thompson said the methods, if perfect, would be of great service, and suggested that a fork so driven be tested optically by comparison with a freely vibrating one. He regarded the mercury contacts used as objectionable, for their capillarity and adhesion would probably cause the impulses to lag behind the appointed epochs. Professor M'Leod remarked that Lissajou's figures gave a satisfactory method of testing the constancy of period, and could be readily observed without using lenses, and in reference to liquid condensers, suggested by the author for his second device, said that platinum plates in sulphuric acid were found to disintegrate when used for this purpose. He thought lead plates would prove suitable. Professor Jones, who read a paper on a similar subject in March last, said he now used bowed forks, with which to synchronize the speed of the disk there described; and the frequency is determined by causing the disk to complete the circuit of his Morse receiver once each revolution.

ON ELECTRIFICATIONS DUE TO CONTACT OF GASES AND LIQUIDS. — A paper on this subject was read by Mr. J. Enright before the Physical Society above alluded to. For some time past the author has been studying the electrical phenomena attending solution by connecting an insulated vessel in which the solution takes place with an electrometer. As a general rule, no effect is observed if nothing leaves the vessel, but, when gases are produced and allowed to escape, the vessel becomes charged with positive or negative electricity, depending on the nature of the liquid from which the gas passes into the air. As an example, when zinc is placed in hydrochloric acid, the deflection of the electrometer is in one direction, while the liquid is chiefly acid, but decreases and reverses as more and more zinc chloride is produced. From such observations the author hopes to obtain some information relating to atomic charges. Owing to the lateness of the hour, the latter portion of the paper and the discussion on it were postponed until the next meeting. For the above reports of the papers read at the meeting of the London Physical Society, we are indebted to *Engineering*.

## NOTES AND NEWS.

A MR. M. W. DEWEY of Syracuse, N.Y., has patented an electric refrigerator, based on the well-known fact that a current of electricity passed in the proper direction across the junction of two dissimilar metals cools the joint. While Mr. Dewey's apparatus is all right as far as the principle is concerned, we would rather not express any opinion on its practical value just yet.

— Beginning with January 1 next, the Rev. T. De Witt Talmage, D.D., will become one of the editors of *The Ladies' Home Journal* of Philadelphia. The famous preacher will have a regular department each month, written by himself, with the title "Under My Study Lamp." His first contribution will appear in the January number of the journal. Dr. Talmage's salary is said to be one of the largest ever paid for editorial work.

— The regulation of the Danube, a work of much importance to the people of south-eastern Europe, has at length been commenced. The first blasts were fired at the Iron Gate early in September, in the presence of the Hungarian minister of public works.

— M. Herman Fol reports to the Académie des Sciences the result of the researches that he has been making in the depths of the Mediterranean during the summer months, his object having been to certify how far daylight penetrates. His operations have been carried on in water of remarkable clearness between Corsica and the shores of the Alpes-Maritimes, at a distance of eighteen geographical miles from the nearest land. M. Fol used gelatino-bromide plates exposed during ten minutes, whereby he has found the limit of daylight in those waters to be at a depth of 1,518 feet (465 metres). This is 327 feet short of the limit assigned to daylight in the Mediterranean by the Germans, Chun and Petersen, some years ago.

— The official list of awards at the Paris Exposition states that there have been given one grand prize to the Johns Hopkins University; one grand prize and one gold medal to Professor Rowland for his photographic map of the solar spectrum, published by the university; one gold medal and one silver medal to the Publication Agency of the university. The exhibit of the university at Paris consisted of sets of the several journals, etc., issued there. A silver medal was also awarded for the map of the solar spectrum at the photographic exhibition in Berlin this summer.

— At the International Congress of Chemists in Paris this summer, it was decided to appoint a commission to consider the subject of chemical nomenclature. The commission consists of Messrs. Berthelot, Friedel, Gautier, Schützenberger, Grimaux, Jungfleisch, Fauconnier, Combes, Béhal, Bouveault (France); Graebe (Switzerland); Alexeieff, Beilstein (Russia); Baeyer, Noelting (Germany); Lieben (Austria-Hungary); Franchimont (Holland); Paterno (Italy); Armstrong (England); Istrate (Roumania); Ira Remsen (United States); Calderon (Spain); Bonkowski Bey (Turkey); Cleve (Sweden); Mourgues (Chili).

— In the new quarterly statement issued on behalf of the Palestine Exploration Fund, it is stated that Dr. Torrance of the Scottish Mission has undertaken to conduct a series of meteorological observations at Tiberias for the fund. Should Dr. Torrance be able to carry out this undertaking, the observations will, with those made at Sarona (now being published by Mr. Glaisher) and those made by Dr. Chaplin at Jerusalem (and reported in the quarterly statement for 1883), as *Nature* points out, place the society after a few years in the possession of materials for a fairly complete account of the meteorology of Palestine. Tiberias is 682 feet below the level of the Mediterranean; and the society hopes that, as no regular series of meteorological observations has ever been made in such a depressed situation, the results may be exceptionally interesting. As the neighborhood of Jericho is becoming to some extent a place of residence for Europeans, the society trusts that opportunity may before long present itself for meteorological observations there also.

— The Archæological Society of Northern Wisconsin is an organization formed for scientific purposes. Its chief object is to collect, arrange, and disseminate facts and material (abundantly scattered over northern Wisconsin) relating to the peoples and tribes who have successively occupied the territory in past times. Every year new facts are disclosed; implements of iron, copper, stone, and clay are unearthed from mounds and graves that go into private hands, and are lost for any public or practical good to which they ought to be diverted. The great mineralogical resources of this region, and its geological features, afford a vast field for investigation. The co-operation of all persons interested in these and kindred subjects is solicited by the society; and contributions of articles sent to the president, Rev. George Gibson (Neenah, Wis.), the secretary, Frank Tilton (Green Bay), or to Mr. F. H. Thurston (Oconto), will be duly acknowledged.

— The *Colonies and India* states that a discovery has recently been made on a Fiji plantation which will probably prove extremely valuable in all tropical countries where the cultivation of bananas is regarded as a settled industry. The banana-disease had for some time been causing much havoc on a plantation on Vanua Levu, and it appears that the discovery of an antidote was due to an accidental occurrence. On a flat near the seashore there was a patch of bananas much diseased, and some time ago the sea swept into it, and remained on it for about an hour. All the plants were killed as far as the standing stems were concerned; but vigorous young shoots came up freely from the roots, and were not only quite free from disease, but soon began to bear much larger bunches of fruit than the parent plants ever did. Upon noting this effect, the planters determined to try the experiment upon a number of badly diseased plants which the sea had not reached. They cut down the diseased plants, and, having stirred the ground about them, poured from one to four buckets of sea-water over each. The result was, that, while the parent stems withered, vigorous young shoots came freely away, without a sign of disease.

— Mr. George F. Kunz, in charge of the Tiffany exhibit at the Paris Exposition, has received from the ministre de l'instruction publique des beaux arts, for his work in connection with the subject of precious stones, the decoration known as l'officier d'Académie, with the right to the purple ribbon known as the "Palm of the Academy." He sailed for New York, Nov. 16.

— The French have long been seeking an expeditious means of communication with the southern provinces of China. *The Chamber of Commerce Journal* of Aug. 5, 1889, reports a discovery which promises to gratify their wishes to some extent. The Marquis de Mores has studied the basin of the Canton River, and in the course of his inquiries he heard that caravans from Yunnan, Sze-Chuen, and other provinces, were in the habit of meeting at Posé, on the Son-ki-kong, a tributary of the Canton River, and a very short distance from the Tong-king frontier. On reaching the Son-ki-kong, accompanied by MM. Thorel and Van Driesche, the Marquis de Mores found that it was a navigable river more than two hundred and seventy yards wide. This river might be placed in direct communication with French territory by a railway about one hundred and twenty-five miles in length. At present the trade of the western provinces of China passes through Canton, and is attended with great difficulty and enormous expense; and the time of transport is sixty to eighty days. It is estimated that this new route would save sixty days on an average, so that Tong-king would have every prospect of becoming the outlet for the trade of the whole of western China. The Red River, which has hitherto been looked upon as the only route into China, has a rapid fall, and ends in a muddy delta which affords no good anchorage. However, according to *Petermann's Mitteilungen* (vol. xxxv. No. 9), a steamer has ascended the river to Laokai on the frontier of Yunnan. The Marquis de Mores found colza, maize, buckwheat, and chestnuts near the river Son-ki-kong. Tobacco, silk, and indigo also are cultivated in small quantities, and their cultivation would probably be much extended if the country were rendered secure from robbers. The exploring party returned to Langson, and thence to Tien-Yen on the coast, a distance of ninety-three miles. The last part of their journey (thirty-seven miles) was performed on the river Son-Tien-Yen, — the only river in Tong-king which yields pure drinking-water, and does not form a muddy estuary. The favorable geographical position of Upper Burmah in regard to Yunnan, however, has not escaped the attention of the British Government; and in this connection it is interesting to note, as pointed out by the *Deutsche Rundschau* (September, 1889), that "by the opening of the Tungu-Mandalay line, the latter town has been brought into railway communication with the port of Rangoon, which has now acquired considerable importance. The railway is to be continued to Bhamo, so that Yunnan and the adjacent provinces of the Chinese Empire will thus be connected with the sea by a much more convenient means of transport than at present exists on their eastern side. Rangoon, and indeed Burmah altogether, will derive much benefit from this line."

— Professor T. H. Lewis, the well-known archæologist of St. Paul, recently obtained a relic of antiquity from Mr. Andrew Wiest of Blakeley, Minn. The relic in question is a small clay cup five inches in diameter and three and one-half inches in depth. The top, or mouth, is four inches in diameter, with a notched rim. The

sides and bottom are ornamented with fine incised lines, and the material of which it is composed is pulverized granite mixed with clay. There is a clay-bed near the village of Blakeley, from which clay is taken for the manufacture of brick. The top of the terrace in which it is situated is about ninety feet above the Minnesota River. At the top there are thirty feet of fine sand, with only a slight covering of loam. Beneath the sand there is a stratum of bowlders, gravel, etc., which is from two to five feet in thickness, below which the clay is found. It was above the bowlders and at the bottom of the sand-bed that the cup, together with some fragments of pottery composed of shell and clay, was found. The distance from the relics to the slope of the terrace in a horizontal line was over one hundred feet, so that their location cannot be attributed to a land-slide, for the strata were unbroken.

— Among recent appointments in the Johns Hopkins University, we note those of Dr. Henry M. Hurd (superintendent of the Johns Hopkins Hospital), professor of psychiatry; Dr. William S. Halsted (surgeon to the Johns Hopkins Hospital), associate professor of surgery; Dr. Howard A. Kelly (gynecologist to the Johns Hopkins Hospital), associate professor of gynecology and obstetrics; Ethan A. Andrews (Ph.D. 1887, late instructor), associate in biology; Dr. Alexander C. Abbott (graduate student 1885–87), assistant in bacteriology and hygiene; William S. Aldrich (U.S.N.), instructor in drawing; Charles A. Borst (fellow 1888–89), assistant in astronomy; Charles H. Chapman (A.B. 1888, fellow 1888–89), instructor in mathematics; George W. Edmond (A.B. 1884), assistant in chemistry; Arthur C. Wightman (Ph.D. 1889), senior demonstrator of physiology; Arthur G. Blachstein (A.B. Cornell 1882, M.D. Leipzig 1887), fellow in pathology.

— The following is a complete list of the papers presented to the National Academy of Sciences during its meetings, Nov. 12–14: "On the Results of the Systematic Study of the Action of Definitely Related Chemical Compounds upon Animals," by W. Gibbs and H. A. Hare; "On the New Prototypes of the Kilogram and the Metre," by B. A. Gould; "Remarks upon the Present State of our Knowledge in Reference to a Revision of the Genera of Brachiopoda for the Paleontology of New York" (Vol. VIII.), by James Hall; "On Zinc Storage-Batteries," by George F. Barker; "On Saturn and its Ring," by A. Hall; "On the Economy of Energy in the Glow-Worm," by S. P. Langley; "On Photometry of Colored Light," by O. N. Rood; "On Certain Pyrophosphates," by W. Gibbs; "On the Vertebrata of the Miocene of the Cypress Hills of Canada," by E. D. Cope; "On the Early Stages of Echinoderms," by W. K. Brooks; "On Relative Wave-Lengths," by A. A. Michelson; "On the Spectrum of Zeta Ursæ Majoris," by E. C. Pickering; "On the Persistence and Meaning of the Bi-concave Centrum of the Vertebræ of Vertebrates," by J. A. Ryder; "On a Peculiar Ordinal Modification as exemplified by Fishes of the Family Halisauridæ," by Theodore Gill; "On the Heredity of Acquired Characters," by W. H. Brewer; "On the 'Positive-Negative' Hypothesis in its Application to Organic Chemistry," by Arthur Michael; "On the Results of the Transits of Venus observed in 1761 and 1769" and "On the Theory of Cosmical Temperature," by S. Newcomb; "The Desert Ranges," by J. W. Powell; "On Hypnotic Cases without Suggestion," by H. C. Wood; "On the Laramie Group," by J. S. Newberry; and "On the Skull of the Gigantic Ceratopsidæ" and "American Mesozoic Mammals," by O. C. Marsh.

— Sponges are found both on the northern and the southern coast of Cuba, but the chief ports to which they are brought for sale are Batabano on the south coast, and Caibarien on the north. British Consul Little of Havana says, according to the *Journal of the Society of Arts*, that the classes included are sheep wool, velvet, hard-head, yellow, grass, and glova. Very little reef, if any, is found in Cuba. On the south coast sheep wool and velvet are more abundant than on the north coast. Cuban sponges find a market chiefly in England, France, and the United States. The island itself consumes about one-tenth of all the sponges brought in, and these are used especially for the damping of tobacco, and for cleaning centrifugal machines on sugar estates. The sponge fisheries employ about a thousand hands, chosen exclusively from among the *matriculados*, or seamen who have served on Spanish men-of-war, and are still bound to serve when called upon. On the south coast are employed vessels ranging from about five to twenty tons, carrying from four to eight men, and each vessel is provided with from three to six small boats. On the north coast open boats with one or two men each are used. The annual value of the sponges brought in by these vessels is between $800,000 and $900,000.

— It is interesting to read of a part of the world where the buffalo is not dying out, but increasing in numbers. A journal of Perth, in western Australia, says that few Australians are aware that certain parts of northern Australia have vast herds of the wild buffalo (*Bos bubalus*) careering over its plains, and wallowing in its shady pools. *Nature* states that the animals are massive and heavy, with splendid horns, and afford sport of a sufficiently dangerous nature to possess charms for the most daring hunter, a wounded buffalo being one of the most dangerous animals known, his great weight, prominent horns, and splendid courage making him as well respected as sought after. The first buffaloes were landed at Port Essington, North Australia, about the year 1829.

— Hitherto Japanese subjects have not been permitted to charter foreign vessels to sail from any but the five treaty ports. An imperial decree has, according to *The London Times*, now been issued, allowing Japanese subjects to despatch foreign vessels to any one of nine other ports, and there to load them with rice, wheat, barley, flour, coal, or sulphur. These vessels may not be used in the coast trade, and permits must be obtained from the Finance Ministry. The new ports are Yokaitchi, in the province of Ise; Shimonoseki, in Nagato; Hakata, in Tshikuzen; Moji, in Buzen; Kuchinotsu and Karatsu, in Hisen; Misumi, in Higo; Fushigi, in Etchiu; and Otaru, in Yezo. Of course, all the ports of the empire will be opened unrestrictedly when the treaties with foreign powers permitting free trade, etc., come into operation.

— The course of lectures at Sibley College by non-resident lecturers in mechanical engineering begins late this year in consequence of the absence of Professor Thurston in Europe until the close of the summer vacation, at the time when it has been customary to arrange the programme, and also in consequence still more of the fact that the lecturers who were expected to open and to appear in the early part of the course have all, for one reason or another, been compelled to ask that their dates be deferred. The course opens on Nov. 22 with a lecture by Professor W. LeConte Stevens on "The History of Aeronautics." This will probably be the introduction to several discussions of this subject, to be given later in the season. The later lectures will probably include one by Professor S. P. Langley, secretary of the Smithsonian Institution, on the results of researches about concluded by him at the Allegheny Observatory, on the laws of aerial flotation and of flight in the atmosphere; and by Mr. O. Chanute, who has been investigating this subject from a theoretical point of view, and who has developed the mathematical side of the theory to a practically applicable degree. Mr. C. E. Emery, the great authority on the subject in this country, will discuss methods of laying-out a steam-boiler plant. Mr. Benjamin F. Isherwood, the engineer-in-chief of the United States Navy during the war, is expected at Cornell in December, when he will give an account of some of those researches which have become famous in the history of the heat-motors. Mr. Alexander Graham Bell will again discuss the curious phenomena discovered by him, which have been given practical interest by his ingenious methods of telephony and telegraphy along a beam of light. At some time during the winter, also, various phases of the engineer's problem of power-development will be discussed by Mr. J. M. Allen, and by Mr. George H. Babcock, the well-known inventor, and ex-president of the American Society of Mechanical Engineers. It is hoped that Mr. Leavit, the great designer of pumping-engines, the consulting engineer of the Calumet & Hecla Mining Company and of numerous other companies, the ex-president also of the Mechanical Engineers, may describe some of his interesting constructions. Mr. Holoway, another past-president of the same society, will talk later of some branch of his work. Professor Anthony, Mr. Weston the electrician, Dr. Dudley the consulting man of science of the Pennsylvania Railway, and Major Michaelis of the Army, are likely to follow later in the season.

# SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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## CONTENTS:



## PROTOPLASM AND ITS HISTORY.[1]

IN the department of biology there are three subjects of transcendent interest; namely, protoplasm or living matter, development, and adaptation. In fact, the interest in some phases of these subjects is now so general and deep that the special students in this department feel that they have to a great extent the sympathy and co-operation of the public at large. This interest renders possible the construction of such commodious laboratories as this the latest acquisition of the University of Toronto, in which we are now permitted to meet. The generous halls and adequate equipment of this laboratory and other biological laboratories throughout our country and Europe testify to the existence of a widespread belief that the new natural history has very much to learn and much to teach in regard to many of the great problems of life.

In the annual gatherings of the members of our section for the exchange of views and for better fellowship, it has been found expedient for us to look at one or the other of these three subjects at the outset of our work in a somewhat broad and yet special manner.

Your chairman for the present year asks the privilege of selecting as his topic for the introductory address the first of the subjects mentioned. You are invited to examine the more recent additions to our knowledge of protoplasm, restricting the examination to discoveries in the field of botany.

[1] Address delivered by Professor George L. Goodale of Harvard University, as vice-president of the Biological Section of the American Association at Toronto, Aug. 28, 1889.

Whether we consider protoplasm, or the living matter of plants and animals, from the point of view of physics, of chemistry, of physiology, or of philosophy, we have before us a topic which has received, and which continues to receive, the most assiduous attention. Hence its literature, though comparatively recent, is appallingly voluminous; and any attempt to treat the subject, or any considerable part of it, exhaustively, within the limits properly imposed upon introductory addresses, would result in annoyance to you and utter discomfiture for me. Apropos of this, I am reminded of a series of experiments upon protoplasm, conducted in a German laboratory, which will illustrate the embarrassment which the case presents. The study to which I refer was with regard to certain organisms of very low grade. At a given period in the life of these organisms, their microscopic masses of protoplasm become confluent in such abundance that sufficient material can be procured for experiments on a large scale. In the special investigation referred to, a considerable quantity of protoplasm obtained in this way was subjected to enormous pressure. You can anticipate the result: there remained behind only a shrunken residue of what we may call, without figure of speech, the most juiceless and the driest of husks.

This natural result of extreme compression has stared me in the face during the preparation of the present address. A similar result is more than likely to follow my attempt to bring within very narrow limits the subject which I have chosen for your consideration.

The word "protoplasm" was coined by Hugo von Mohl in order to designate certain active contents of the vegetable cell.

We shall gain in clearness of vision by letting our glance rest first on the results of investigating vegetable cells and cell contents anterior to Von Mohl's time, in order that we may see some of the steps by which this term was reached by him. The compound microscope was not applied seriously to the examination of the structure of plants until about fifty years after its discovery by Drebbel. In 1667, Robert Hooke of England published an account of his investigations of minerals, plants, and animals under the microscope, and gave excellent illustrations of what he thought he saw. His first reference to the structure of plants is in his description of charcoal, and this is followed by a good account of common cork. In these brief and fairly accurate descriptions, the author makes use of the word "cell," applying the term to the cavities in charcoal and in cork.

Hooke's interesting treatise was soon followed by two remarkable memoirs, — one by an Italian, the other by an Englishman. Malpighi of Bologna sent to the Royal Society of London in 1670 a work entitled "Anatome Plantarum." The published volumes bear the dates 1675 and 1679. At the period these volumes were in the hands of the Royal Society, Nehemiah Grew, secretary of the society, was engaged in work almost identical with that of Malpighi; but there is no good reason to believe, as was formerly intimated, that he was indebted to Malpighi for any of the statements which he published as his own. It is, however, best for us to consider these two works together. By Grew the term "cell" appears to have been applied to the cavities in what we may term the softer tissues of the plant. It is certain that neither Malpighi nor Grew recognized, as we can now, the multifarious forms of vessels, fibres, long cells, and the like, as referrible to a common source. There is always a strong temptation to read in an old text some meaning which squares with our own notions; and one is greatly tempted to think that these assiduous investigators, Grew and Malpighi, detected the relationships which we know exist between the different elements of vegetable structure. But after giving them the benefit of every doubt, one fails to find in their writings any recognition of such affinities. On the contrary, these investigators were engaged in a study which naturally led them away from such conceptions. They were busy with descriptive work, outlining the arrangement of tissues in all organs of the plant which their knives could reach. They did not even break up the tissues into elementary parts, but they described and delineated with great skill the tissues as they were displayed in sections. Is it not incredible that these first works on vegetable structure, prepared only a few years after the earliest application of the compound microscope to the study of plants, should have remained for

almost one hundred and fifty years the only comprehensive treatises on the subject? But the most charitable inquirer fails to find during that long period any other works of importance on vegetable anatomy.

Near the close of the last century, at a period characterized by activity in many departments of speculative inquiries, the subject of vegetable structure again excited considerable attention, but little substantial advance was made. In 1804 the Royal Society of Sciences at Göttingen proposed for competition certain questions relative to the structure and the mode of growth of tissues. The chief contestants for this prize were Link, Rudolphi, and Treviranus. The memoirs of the first two received the prize; that of the latter, honorable mention. The names of others should be referred to as having worked at or about this time in the same field; namely, Bernhardi, Mirbel, and Moldenhawer, the last making a great advance in certain directions. But to all of these whom I have mentioned, including the winners of the prize, the important question seems to be, how are the structural elements distributed, rather than how are they related to each other in manner of growth and as respects their origin. With the cell contents they had comparatively little to do. They were busy with the constituents of the framework.

There appears to have been a strong suspicion, on the part of some botanists during that period, that all this study of the skeleton of the plant failed to go to the bottom of the question. The only wonder is, that with their scanty and untrustworthy chemical appliances, and with their very imperfect lenses, they accomplished so much. May I remind you that the element iodine, which is the most important re-agent in the examination of the contents of vegetable cells, was not employed until the year 1812; and, further, that no good achromatic and aplanatic lenses, of even moderately high power, were constructed until 1827?

Noting the more important discoveries of the next period in their order, we come first upon that of the nucleus of vegetable cells by Robert Brown in 1833, and one mode of cell-division by Mohl in 1835. In 1838 the eccentric Schleiden published his "Contributions to Phytogenesis," in which he states substantially that cells of plants can be formed only in a fluid containing, as chief ingredients, sugar and mucus (*schleim*). By this latter term he designated the nitrogenous matters taken collectively. At his touch all disguises fell, and for the first time the vegetable cell was distinctly recognized as a unit of structure always serving as the common basis for the formation of the innumerable shapes of the structural elements.

Next comes the master, Mohl. Armed with the best optical appliance procurable, familiar with the use of the chemical re-agents then at command, and accustomed to accurate research, he reviews his own earlier work and that of his contemporaries, making rapid advance in the knowledge of the contents of the cell. In 1844, in a paper on the circulation within vegetable cells, he speaks of the living mass in each active cell, and distinctly recognizes it as that which is the treasury of stored energy and the vehicle of energy under release. He describes it as that which builds shapely forms out of unformed matter and at first hands. This substance he names "protoplasma."

If we look at the handbooks of botany just before this date of the early forties, we find references to "coagulable matters" (Treviranus), and the chemical instability of the substance within cells was suspected of having much to do with its activity; but almost all of the notes, as well as those upon the same subject found here and there in philosophical writings of the latter part of the last century, are based on pure speculation. The scientific recognition of a physical basis of vital activity must be credited to Schleiden and Mohl.

The term "protoplasm" was at once adopted by Schleiden, and a good substitute for the indefinite and misleading word *schleim*, which he had employed to designate essentially the same substance, and it became thoroughly established in scientific terminology. In 1850, Professor Cohn (and Unger in 1855) showed that the protoplasm of vegetable cells is identical with what had been described in 1835 in animal structures as *sarcode* by Dujardin, and this prepared the way for the exhaustive treatise by Max Schultze in 1858. From that date on, work in the contiguous fields of botany and zoölogy has made no physical or chemical distinction between the living matter in animals and plants. Investigators in the two fields have been mutually helpful.

Mohl, in his treatise on the vegetable cell, published in 1851, gives the following account of protoplasm: "If a tissue composed of young cells be left some time in alcohol, or treated with nitric or muriatic acid, a very thin, finely granular membrane becomes detached from the inside of the walls of the cells, in the form of a closed vesicle, which becomes more or less contracted, and consequently removes all the contents of the cell which are enclosed in this vesicle from the wall of the cell. Reasons hereafter to be discussed have led me to call this inner cell the 'primordial utricle' (*primordialschlauch*). . . . In the centre of the young cell, with rare exceptions, lies the so-called *nucleus cellulæ* of Robert Brown ('*Zellenkern*;' '*Cytoblast*' of Schleiden). . . . The remainder of the cell is more or less densely filled with an opaque, viscid fluid of a white color, having granules intermingled in it, which fluid I call 'protoplasm.'"

We must now pass without notice numerous contributions to the subject, and consider Hofmeister's description of protoplasm given in his "Vegetable Cell," published in 1867: "The substance protoplasm, whose peculiar behavior initiates all new development, is everywhere an essentially homogeneous body. It is a viscid fluid containing much water, having parts easily motile, capable of swelling, and possessing in a remarkable degree the properties of a colloid. It is a mixture of different organic matters, among which albuminoids and members of the dextrine group are always present. It has the consistence of a more or less thick mucus, and is not miscible with water to any great extent."

From these accounts we see that the following points were regarded as established: 1. All of the activities of the vegetable cell are manifested in its protoplasmic contents; 2. Protoplasm consists chemically of a nitrogenous basis; 3. Protoplasm has no demonstrable structure; 4. The protoplasmic contents in one vegetable cell are not connected with the protoplasmic contents in adjoining cells; 5. The nucleus and other vitalized granules in the vegetable cell are formed by differentiation from amorphous protoplasm.

It is now our duty to see in what manner these views have been modified during the last twenty, or rather ten, years. In describing the changes of opinion, time will not suffice for us to allude to most of the observers: a few only can be mentioned by name.

The first thesis, namely, that all of the activities of the vegetable cell are manifested in its protoplasmic contents, may be regarded as firmly established. It is at this point in our present examination when, if we had time, we should take up, one by one, the terms which have been applied to some parts of what Mohl and Hofmeister knew as protoplasm. But we can only glance at them in passing. Thus, "cytoplasma" is understood to be the mass exclusive of the granular contents of all kinds; "hyaloplasma" is the outer hyaline layer; "polioplasma" is the grayish granular part. To these terms may be added others, such as "paraplasma," etc.

The second thesis, viz., protoplasm consists chemically of a nitrogenous basis, remains unchanged. But, instead of regarding the protoplasmic basis as comparatively simple, it is now known to be exceedingly complex, and to contain numerous cognate proteids, some of which can be identified in the basic mass, others in the nucleus, and others still in the vitalized granules.

These researches must be considered also with reference to those by two active investigators, Pfeffer and De Vries. The former has shown the conditions under which active protoplasm re-acts in the presence of certain chemical excitants: the latter has demonstrated the relations of a part of this irritability of protoplasm to its physical constitution. But, as a result of all these recent studies, it becomes more and more clear that the chemical relations of the protoplasmic activities are still veiled in mystery. Botanists are receding from a position held by many only a few years ago; namely, that it is safe to use the words "albuminoids" and "protoplasm" interchangeably. Nowadays the latter term is generally restricted to morphological and physiological conceptions: the former keeps its wide chemical significance.

Just here come in the chemical studies of protoplasm, — by

Rodewald and Reinke on a large scale, by Loew and Bokorny, and by Schwarz under the microscope. All of these results compel us to recognize in protoplasm a substance of bewildering complexity of composition and constitution. Moreover, you all know how wide this field of research has suddenly become by the discovery that different microbes (which are essentially minutest masses of protoplasm) not only give rise to such diverse products, among others the ptomaines, but present such diverse chemical re-actions.

Protoplasm is no longer regarded by any one in any sense as a comparatively simple substance.

The third thesis, namely, protoplasm has no demonstrable structure, has been modified in a striking manner as a result of improved appliances for research. By better methods of staining, and by the use of homogeneous immersion objectives, the apparently structureless mass is seen to be made up of parts which are easily distinguishable. There has been, and in fact is now, a suspicion that some of these appearances, under the influence of staining-agents, are post-mortem changes, and do not belong to protoplasm in a living state. But it seems to be beyond reasonable doubt that protoplasm is marvellously complex in its morphological and physical as well as its chemical constitution. One statement of the case is as follows: Under ordinary circumstances, protoplasm is composed of a mesh of inconceivable fineness, in which mesh are entangled the more liquid interfilar portions (paraplasma); so that the dry husks left in Reinke's experiment may be regarded as the residue of network from which all the moisture has been expelled. But this conception of protoplasm as a mass composed of a network of minutest fibres enclosing in the meshes another substance, presents, as has been well shown by some critics, great difficulties when we endeavor to explain the movements within the cell. It is very difficult to explain in any way the so-called wandering of protoplasm outside the cell wall or into intercellular spaces.

Fourth, we are to glance at the accepted statement that the protoplasmic body or protoplast, as it is called, of one cell is cut off by the cell wall from all connection with the contiguous cells. There are a few cases in which this intervening wall was formerly held to be pervious, but such cases were considered as exceptional. Now, however, as has been shown by Gardiner and others who have followed out his exact researches, there are intercommunicating threads of protoplasm of extreme fineness between adjoining cells; and these living threads maintain connections, sometimes direct, sometimes indirect, between one protoplasmic mass and another. This has been shown to be so widely true in the case of the plants hitherto investigated, that the generalization has been ventured on, that all the protoplasm throughout the plant is continuous. The formation of the dividing wall in cell-division is now better understood than ever before, and our knowledge of this process lends great probability to the truth of the general statement made. It is not unlikely, then, that all the living matter throughout each plant is continuous, a whole, shut off at the time of severing from the mother-plant from the body of protoplasm there, and thus making a true chain of descent.

May I ask you to observe, in passing, how this bears on the vexed subject of individuality of plants? Brücke, in 1862, declared that the living protoplasmic contents of a cell formed an elementary organism, and this idea found its fullest expression in the profound work by Hanstein in 1880. In that treatise Hanstein proposed for the living protoplasmic contents of the cell the term "protoplast," in order to indicate its individuality. But these late researches show that these protoplasts are not only highly organized and of complicated structure, but each is bound by indissoluble ties to its nearest neighbors, each helping to form a united whole.

The fifth thesis has been completely controverted. Instead of believing, as formerly, that all the granules within the cell arise *de novo* from the protoplasm in which they are embedded, we are now forced to regard all of them as springing from pre-existent bodies of the same character.

Hofmeister, in 1867, in an exhaustive description of the contents of vegetable cells, states distinctly that the nucleus arises from homogeneous protoplasm, and that in all cell-division the nucleus must first disappear, two new ones arising in its place. The nucleus occupied a secondary place as a derivative organ; and the chlorophyl granules were believed by him and his contemporaries to be new formations from homogeneous protoplasm under certain conditions of light, temperature, and food. Researches which leave no room for doubt have shown that the nucleus, in all cases hitherto examined, springs from a pre-existent nucleus by a process of division. The process of division, with its marvellous sequence of formal arrangements of definite portions in meridional lines and in polar and equatorial masses, has been most carefully examined in almost every organ of the plant, and in connection with similar processes of cell-division in animal tissues. In no well-marked case has a nucleus been observed to arise from homogeneous protoplasm, even a few doubtful instances having been lately explained satisfactorily.

The extraordinary manner in which the nucleus, both in common cell-division and in reproductive blending, carries ancestral characters and controls the distribution of nutritive materials, is as yet the greatest mystery in vegetable life.

We pass next to consider a very important change of view in regard to the other granules embedded in the protoplasmic body, known as leaf-green or chlorophyl granules. Formerly, as we have noticed, it was held that all of these sprang by a process of differentiation from the shapeless mass in each exposed cell. Researches by Schmitz on some of the lower plants, and by Schimper and Meyer on the higher, have shown beyond any reasonable doubt that these chlorophyl granules always arise by a process of division from pre-existent granules; but this fact, taken by itself, might not possess great interest. It is, however, known, that, at the growing points where leaves are developed, the cells contain in their protoplasm granules of about the consistence and color of protoplasm itself; and these granules have the power of division, much after the fashion of the cell nucleus. But the products of such division are essentially threefold: some of the resulting granules are colorless, like the mother granules; others become true chlorophyl granules; while others still, in those leaves which become the leaves of the flower and the fruit, assume colors other than green. In other words, we have in these associated granules, or chromatophores, a morphology which is of the highest interest. The needs of the plant bring from this common source the microscopic organs for assimilation, for storing up starch in the form of grains, for protection and attraction. This most interesting generalization in regard to the granules taken together adds a new zest to the study of the developing plant and the evolving species.

It has been lately claimed by De Vries of Holland that the sap-cavities or vacuoles in protoplasm divide in much the same way as do the granules just referred to, but this part of the subject is not yet beyond all doubt. That the sap-cavities are the birthplace of most crystals, and that the aleurone grains may be desiccated sap-cavities, has been made out by several observers. But it is not clear that vacuoles divide as granules do. What we do know beyond all reasonable question is this, — that all the working granules within the plant have sprung from pre-existent granules, and that there is no break here in the transmission from parent to offspring.

Such, then, are some of the more important changes which have taken place with regard to our knowledge of the living contents of vegetable cells. I would gladly take the time, if it could be granted, to call your attention to certain most interesting discoveries which have been made by Pfeffer, relative to the absorption of coloring-agents by living protoplasm, and which have been supplemented by Campbell in regard to the nucleus; but more than this allusion is now impossible.

It is an interesting coincidence that with the substitution of the crude compound microscope for high-power simple lenses, in 1660, came the first works on vegetable structure; and for more than one hundred years, or until the introduction of achromatic object-glasses, these works were, in truth, the only authoritative treatises. With the introduction of water-immersion lenses came renewed activity in this field, and with the later discovery of homogeneous immersion lenses came the results which have now been detailed. Whether we have, at these stages, more than a series of interesting and very striking coincidences, or not, we have not time now to discuss. It is enough for our present purpose to observe, that, with the introduction of the cedar-oil immersion objectives, a

thorough re-investigation of certain parts of this subject began. One may be pardoned for asking whether the objectives known as apochromatics are to open up in this field new lines of research.

Can these recent discoveries relative to the continuity of protoplasm and the genetic relationship of the associated granules (including, in the widest sense, the nucleus) be made to cast any light on the question of development, as they certainly do upon the kindred question of adaptation? The answer has been given us very lately by Hugo de Vries of Amsterdam. This investigator, who has done very much to clear up certain obscurities in regard to the external relations of the cell, has recently revised the neglected doctrine of pangenesis, and applied it to the question just propounded. De Vries suggests that we divide the hypothesis of pangenesis as proposed by Darwin into two parts, as follows: 1. In every germ-cell, individual characters of the whole organism are represented by material particles, which, by their multiplication, transmit to descendants all of such peculiarities; 2. All the cells of the organism throw off, at certain periods of development, such material particles, which flow towards the germ-cells, supplying its deficiencies. Now, De Vries asks whether it is not high time for us to look at the first part of this hypothesis again, and abandon the hinderances which the latter part imposes. If we accept his suggestion, and restate the hypothesis, in view of what has been learned relative to the nucleus and other granules (the trophoplasts) within the cell, we should then read, "In every cell at a growing part are all the elements ready for multiplication. Each protoplast possesses the organs necessary for continuous transmission; the nucleus for new nuclei, the trophoplasts for new granules of all kinds, according to the needs of the plant."

The author reviews the theories bearing on the question, from the so-called plastidules of Elsberg to the germ-plasma of Weismann, and then applies his hypotheses of intracellular pangenesis to the different parts of a single plant, and to the transmission of peculiarities. The active particles recognized in Darwin's hypothesis he terms "pangens," and, regarding them as vehicles of hereditary characters, traces them throughout their course. He is not obliged to ask for any means of transportation for these pangens, for they work, so to speak, on the spot. They are ready at hand at the points of growth. We must look very sharply with reference to this at two points of growth in the flowering plant; namely, the bud and the seed. Each bud, with its growing point made up of cells containing in their protoplasm the divisible granules, carries with itself all the peculiarities which have been transmitted without appreciable change. In the formation of the bud there is fission, but no blending. The cells divide, and each new one may in turn divide until the ultimate form of the leafy branch or flower is reached. In the leafy branch new buds form, and in their turn carry forward the ancestral peculiarities; but in the flower, on the other hand, with the formation of the ovule all development is arrested (except in the rare cases of parthenogenesis and the like) unless the protoplasm of the embryonal sac receives a new impetus from material contributed by the pollen grain; and in this blending of parts which have developed under different external conditions, we see that there is a chance for variation to come in. Not only is there a blending of the nuclei, but a sharing of the accompanying trophoplasts. How this can be applied to the lower plants and other organisms cannot now be referred to. It would not be right to hold De Vries wholly responsible for the application just given, but I ask you whether the hypothesis does not appear fruitful. It seems likely to stimulate speculation and further research in this important field.

In view of De Vries' work, and of the results of recent study, which I have endeavored to bring before you this afternoon, does not the statement of Darwin possess new force? — "An organic being is a microcosm, a little universe formed of a host of self-propagating organisms inconceivably minute, and as numerous as the stars in heaven."

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HOUGHTON, MIFFLIN, & CO. have in press a biography of Wilbur Fisk, the Methodist minister, by Professor George Prentice of Wesleyan University, to form the second volume in their new series of American Religious Leaders.

## THE ORNITHOLOGISTS' MEETING.

THE seventh congress of the American Ornithologists' Union began its session in the rooms of the American Museum of Natural History in this city, Nov. 12. Dr. C. Hart Merriam, from the committee on the migration and geographical distribution of birds, reported that no progress had been made in studying migration; but the Agricultural Department, he said, is now engaged in work relating to floral and faunal distribution. Individual species of birds are first located and mapped, and then these maps are co-ordinated so as to define the natural floral and faunal areas of the country. These maps will be colored so that one may see at a glance the boundaries in which certain flora and fauna abound. Dr. Robert W. Shufeldt, from the committee on the anatomy of birds, reported the progress made in the study of this anatomy for the years 1888 and 1889. The report named the books that had been published in Europe and America on this subject during the last two years. George B. Sennett, from the committee on the protection of North American birds, reported that the committee was doing what it could to protect useful birds and destroy others. They encouraged boys to kill sparrows, but to spare other birds. The New York law for the protection of birds was defective. This was to be regretted, for New York is the great market. The Pennsylvania law had been drawn with a knowledge of the defect in the New York law, and is the best law now in existence in any State.

On Wednesday, the 13th, Jonathan Dwight, jun., read a paper on "Birds that have struck the Statue of Liberty, Bedloe's Island, New York Harbor." He said, that, on account of its lighter color, more birds strike the pedestal to the statue than the statue itself. The statue was erected too late in 1886 for the migratory birds. The first to strike it was on May 19, 1887, and the next late in August, when the lights were said to be put out by birds. The first date at which birds struck the statue in 1889 was Aug. 5, when fourteen were killed. A few others were killed during the month, and a considerable number in September and October. Oct. 24 was the last date at which birds were killed. The whole number killed this year was 690, which was considerably less than in 1888 or 1887. He found that every cold wave in the early fall was followed by migratory birds flying against the statue. Of the dead birds picked up this year, 60 per cent belonged to one species, the Maryland yellow-throats. The remaining 40 per cent included a great variety. A paper on "The Abundance of the Wild Pigeon in Central and Eastern New York in 1835," prepared by Professor R. W. Whitfield, was read by Mr. Dutcher. Early in the sixties there was a great flight of pigeons in the Hudson valley. Flocks were so large that one could not see their extent, and they cast shadows like clouds. Dr. C. Hart Merriam said the gregarious habits of pigeons had made their struggle for existence peculiarly hard, because they were so liable to attack on their breeding-ground. The result was, the few survivors have learned to abandon the old habits, and they now scatter and breed in isolated pairs. There was no danger that they would be exterminated. A paper was read by Dr. Edgar A. Mearns, entitled "Observations on the Avifauna of Arizona." After brief discussion, Dr. C. Hart Merriam read a paper entitled "Remarks on San Francisco Mountain and Vicinity (Arizona) from the Faunal Standpoint." "The Winter Distribution of the Bobolink, with Remarks on its Routes of Migration," was the subject of a paper by Frank M. Chapman. After some discussion, Mr. Chapman read another paper, "On the Changes of Plumage in the Bobolink."

At Thursday's session Mr. Leverett M. Loomis read a paper, giving his observations on some of the summer birds of the alpine portions of Pickens County, S. C. Col. N. S. Goss, State ornithologist of Kansas, read two brief papers, — one on the question whether the poor-will and the frosted are varieties of the same species, or distinct; and the other on "The Mottled Duck in Kansas." Jonathan Dwight, jun., read a paper on "Some Birds observed near the Straits of Mackinaw during 1888." In a search for a pigeon-roost, Mr. Dwight came upon a parade-ground of migrating birds in Michigan, and, in a few days following the 20th of May, secured a great number. He had prepared a list of 119 species thus secured. Dr. Edgar A. Mearns read a paper, "The Western Form of the Warbling Vireo." Mr. William Brewster

gave the substance of two papers, — one on "The Little Brown Crane in Rhode Island," and the other on "The Capture of the Canada Jay near Cambridge, Mass."

At the closing session of the congress on Friday, President J. A. Allen presented a paper on the classification of the Maximilian types of South American birds now in the American Museum. He also presented a paper on "Seasonal and Individual Variation in Certain Flycatchers of the Genus Elænea." Mr. Frank M. Chapman read a paper on "The Forms of the Maryland Yellow-Throat." President Allen read a paper on classification, in which the difficulties of the work were made evident.

The next congress will be held in Washington the third Tuesday in November, 1890.

## BOOK-REVIEWS.

*The Continuous Creation.* By MYRON ADAMS. New York, Houghton, Mifflin, & Co. 12°. $1.50.

THIS work is one of those attempts, now so numerous, to reconcile Christianity and science. The author is a clergyman, and the views set forth in this volume are such as he has long taught to his congregation. He accepts the evolutionary philosophy quite as unreservedly as any scientist could do, and endeavors to show that it is in no way hostile to any essential truth of religion. There is nothing in his views or arguments that is specially new; but they are presented in a style that is somewhat above the ordinary, being not only clear and refined, but also of a true literary flavor. Mr. Adams holds the view, which other Christian thinkers have expressed, that evolution is "the mode of God in doing things, in causing things to come to pass." Creation is conceived as a continuous and never-ending process, and evolution as the universal law of becoming." This idea of continuous creation is nothing new, but has been held by many philosophers of the past, including the Alexandrian Christians. But the prevalent doctrine of the Church has regarded creation as a work done once for all by an omnipotent *fiat;* and hence, when the evolution theory appeared, it was found to be out of harmony with the orthodox view. Of course, Mr. Adams has no difficulty in showing that the new theory is in no way inconsistent with a philosophical theism. It is curious, however, that nearly all the criticisms of Christianity with which the world is now rife should be attributed to the evolutionary school, for very few of them are original with that school. Most of the changes now going on in the traditional religion are due to other influences, and would have taken place just the same if evolution had never been thought of. How far those changes have already gone, Mr. Adams's book plainly shows; for his Christianity is so different from that of former times that it is hardly recognizable under the same name. But he shows an excellent spirit and a true religious earnestness, and his work will be interesting to those who are interested in its subject.

*The Public Regulation of Railways.* By W. D. DABNEY. New York, Putnam. 12°. $1.25.

THIS is one of the most sensible books on the railway question that we have seen, though it cannot be said to offer much that is original. Most writers who discuss the railway question are animated either by hostility to the railway companies or by partiality for them; and it is pleasant to read a work that discusses the subject in a judicial spirit. Mr. Dabney's book consists of two parts: the first dealing with the legal aspects of the subject; the second, with the economical. He is opposed to any scheme for the purchase and operation of the railways by the government, and gives the usual reasons for this view. But, on the other hand, he holds that the partial monopoly that necessarily attaches to the railway business, and the vast power over industrial interests which the companies wield, make it necessary that they should be carefully supervised by public authority. He goes into the details of many judicial decisions and questions of law affecting the railways, and then takes up such questions as those of pooling, discrimination, "the long and short haul," and many others; and his opinions, whether one agrees with them or not, are evidently the result of careful study. He condemns discrimination between persons in unqualified terms, but thinks that discrimination in favor of certain places is sometimes not only justifiable, but inevitable. The work is worthy of perusal by all who wish to understand the subject and to see justice done to all parties.

*Pawnee Hero Stories and Folk-Tales.* By GEORGE B. GRINNELL. New York, Forest and Stream Publ. Co. 12°. $2.

THE author of this work has lived for several years among the Pawnees, and, during his last visit to the tribe, gathered as many of their familiar stories as he could, and set them down in writing precisely as they were told to him. The hero stories are mostly warlike, and relate particularly to horse-stealing, which, as Mr. Grinnell reminds us, was simply a mode of warfare. It appears that the Pawnees are adepts in personating wolves by dressing themselves in skins or other appropriate disguises, and crawling on all-fours; and by this means they could approach close to an enemy's camp without being discovered. Many of these stories recount such exploits, and some are quite diverting. The folk-tales are far more fantastic, and are full of the marvellous; as, for instance, the story of the Dun Horse. This animal was very wise and a good conversationist; but after a while he died, and the men of the tribe cut him up into little pieces. Very soon, however, a strong wind blew upon the pieces, and they were put together again, and the horse restored to life.

Besides these native stories, Mr. Grinnell gives us a series of notes on the Pawnee people and their customs, which will be of use to students of such subjects. He attempts to trace the origin and migrations of the tribe, but reliable information on these points is very scanty. The religious sentiments of the Pawnees are said to be strong, and their religious exercises frequent and fervent. Some marvellous and inexplicable tales are told, and stated to be true, of the doings of their medicine-men. The Pawnees are now settled in the Indian Territory, and are rapidly dwindling in numbers. When the author first visited the tribe, "it numbered more than three thousand people: now there are only a little more than eight hundred of them." He thinks that some measures ought to be taken to preserve a record of their language, and suggests that the Smithsonian Institution should take the matter up.

*Electricity in our Homes and Workshops.* By SYDNEY F. WALKER. New York, Van Nostrand. 16°.

THE ground covered by this work is somewhat limited, but it is gone over thoroughly and conscientiously, leaving little to be desired even by the most exacting. The intention of the author when he began his task, as intimated in the preface, was to cover the whole ground occupied by electrical apparatus; but circumstances compelled him to limit his labors to what are known as auxiliaries to the practical business of life, — those in which only small currents are used. We hope, however, that the author, when he realizes the eagerness with which books on such subjects, written by competent men, are looked for by all interested in the popular side of electrical progress, will give us something in a similar vein on electric lighting, transmission of power, electrical measurements, and other topics.

Mr. Walker explains, in easily understood terms, the every-day working of many of the forms of electrical apparatus with which experience has made us more or less familiar; that is to say, he explains, in language devoid of unnecessary technicalities, the working of an electric circuit, the properties and application of the magnet, and the theory and operation of galvanic batteries. He also gives some chapters to electric bells and their fittings, to electric mining signals and their operation, and to telephonic apparatus. But the most interesting chapter in the book is that which the author calls a "glossary of terms," but which is really something more. It is by far the best popular explanation of electrical terms, considering its brevity, that we know of; and, now that the daily press is giving us a brief respite from the "overhead wire" sensation, we would commend this glossary to the newspaper reporters, so that they may be prepared to do full justice to the technicalities of electricity as soon as that subject comes uppermost again. The multifarious uses of the electrical current have become so necessary a part of our daily life, that those who wish to speak or write intelligently of it must pay attention to its terminology.

The book is well printed, neatly and substantially bound, and is illustrated by 127 engravings.

*The Works of Walter Bagehot.* Ed. by FORREST MORGAN. Hartford, The Travelers Insurance Co. 5 vols. 8°. $5.

THIS fine edition of Bagehot's works will be very welcome to students of theoretical and practical politics. The editor's original intention was to issue simply a reprint of such of the author's writings as had already appeared in England; but he soon found that the text was badly corrupted, owing mainly to Bagehot's slovenly style of writing, and to the fact that he often failed to correct his proofs. Proper names were found to be misspelled in many cases; grammatical blunders of the worst kind were numbered by scores; and, worst of all, the quotations, which are so frequent in the essays and elsewhere, were more often wrong than right. Many of these errors Mr. Morgan has corrected silently; but some of the quotations are so badly mangled that he has left them in the text as the author wrote them, and has given the correct form in a note. The works are prefaced by a memoir by Mr. R. H. Hutton, which was published in England soon after Bagehot's death. Then follow three volumes of essays, mostly biographical or literary; while the two concluding volumes contain the more elaborate works on "The English Constitution," "Physics and Politics," and others.

That Bagehot holds a high rank as a political thinker and writer is undeniable, for he was not only the author of the works here collected, but also a leader of thought on practical affairs by means of his editorials in the *Economist;* yet his writings are very unequal in merit. His political views were too oligarchical, and he even went so far as to applaud Louis Napoleon's *coup d'etat*, and to hail the perpetrator of it as a savior of society. The work on "The English Constitution" is the best known, and in our opinion the ablest, though Mr. Morgan gives the preference to "Physics and Politics." The studies in economics are suggestive, and serve to correct and complete some theories of the earlier writers. This edition is a very handsome one; and, as it is sold at the extremely low price of five dollars, the publishers can only find their recompense in the reputation the work will bring them.

## AMONG THE PUBLISHERS.

JOHN WILEY & SONS have in press the first part of a Ruskin bibliography.

— An interesting table of contents is presented in *Belford's Magazine* for November. Besides a complete novel, "In God's Country," by D. Higbee, there are several shorter stories and poems by well-known writers, some timely editorials, and a few book-reviews. Felix Oswald writes interestingly on the "Curiosities of Longevity;" "The Labor Problem" is discussed by Alfred F. Jury; and, under the title "The Failure of Democracy," Clinton Furbish points out the way to prevent such a catastrophe.

— Dr. William Perry Northrup has written for the December *Scribner* some picturesque impressions of a summer in Brittany, describing particularly the pardon of Ste. Anne d'Auray, a unique religious festival. Ex-Minister Edward J. Phelps, in his article on the age of words, writes rather disparagingly of contemporary fiction. Edgar Mayhew Bacon will present a humorous view of Bahama negro character.

— In an article on "Building Associations," in the December *Lippincott's*, Thomas Gaffney describes the benefits that accrue to the members of these institutions, tells how to form and run such associations, and points out their influence for good upon the nation at large. In "Novelistic Habits and 'The Morgesons,'" Julian Hawthorne gives his theories as to how novels should be written. In the same number William Shepard tells about "The Evolution of Famous Sayings," and shows how many famous *bon mots* and epigrams antedate the existence of the men who are generally supposed to have originated them.

— Robert Bonner's Sons have ready "Great Senators of the United States Forty Years Ago (1848–49)," by Oliver Dyer, at that time a reporter in the Senate for the *National Intelligencer*, which was forty years ago a widely circulated newspaper. The author came into close contact with the distinguished statesmen of his day, and gives personal recollections of Calhoun, Benton, Clay, Webster, Gen. Houston, and Jefferson Davis, and many less-known men.

— Gebbie & Co. have just issued a publication on a subject that is at present attracting attention, electricity. It is entitled "Babylon Electrified," and is written by A. Bleunard, a French scientist, and not only comprises an account of travels from London to Babylon, but demonstrates by imagination the present possibilities of electricity. It is illustrated by numerous engravings by Montader.

— Messrs. Putnam have issued a reprint of "Money," by James Platt, — a book that has had a large sale in England, though why it should have it is not easy to see. It is, indeed, a sensible and conscientious work; but it contains nothing new or striking, and the style is rambling and somewhat garrulous. It may be this very style, however, that makes the work popular. Mr. Platt's views are sound and practical, being in fact the views held by most English economists. He justly holds that a correct knowledge of money and credit is essential to the prosperity of a nation, and that such knowledge is not to be had without some study. He gives an account of the nature and uses of money and also of its history, and then follow chapters on banking, interest, panics, and other matters connected with the general theme. He shows a thorough knowledge of the subject, both in its theoretical and in its practical aspects, and the reader who is not familiar with the economics of money will obtain a good deal of information from its pages.

— In *The Chautauquan* for December, Professor James A. Harrison of Washington and Lee University has the first of a series of papers on the archæology of Italy; "The Humors of Ignorance" is an article by W. S. Walsh, in which many instances are cited to show how ignorant an intelligent person may be on subjects which everybody expects him to know; W. T. Hornaday tells of the destruction of our wild animals; Dr. J. M. Buckley continues his discussion of "Traits of Human Nature;" an answer to the question "How can I become a distinct speaker?" is given by Professor R. L. Cumnock of North-western University; Ernest Lambert tells about the Island of Jersey, its history, its relics and antiquities, and the peculiarities of its people; the issue contains a study of "Modern English Politics and Society," by J. Ranken Towse; there is an article by Professor R. F. Weidner, D.D., of Augustana Theological Seminary, on "Recent Objections to the Bible Answered;" some statistics are given in an article on "Working-Girls;" "An Indian's Memory, How Long is it?" is discussed by Egerton R. Young; and "Convict Labor in Alabama" is treated by Ernest Ingersoll.

— The Hon. Edward S. Phelps, lately minister to England, has prepared for the December *Forum* an article on divorce. A contribution to the literature of the controversy about Romanism will be made by Bishop McQuaid of Rochester, N.Y. He undertakes to show that the common-school system is paternalistic and socialistic in its tendencies, and that a gross wrong is done to Catholic parents by taxing them to maintain the public schools. The organization of farmers into granges, alliances, wheels, and combinations by other names, has for two years been going on at a much more rapid rate than ever before. The limit of the old grange movement has long ago been passed. These organizations now contain a membership of a million, and a movement is on foot to consolidate the granges, the alliances, and all the other combinations. An explanation of this movement, as well as of the aims and methods of each organization (all of which are secret), will be published in this number by W. A. Peffer of Kansas. An old plan to solve the race question in the South, namely, by promoting emigration to the West Indies, to Mexico, or to Africa, is revived simultaneously by persons who approach the problems from many points of view. The Mexican Government is reported to have the subject under consideration. A colored man from the South is lecturing in some of the Northern cities in favor of this scheme, and advocates of it are presenting it in books and periodical literature. Professor Henry A. Scomp of Emory College, Georgia, who looks at the subject from the Southern point of view and with sympathy for the colored race, has prepared an article for *The Forum*, in which he undertakes to show that assisted emigration is the only solution of the negro problem, and affords the only means of escape from dangers that constantly become more menacing.

Publications received at Editor's Office,

Nov. 4-16.

ADAMS, M. The Continuous Creation. Boston and New York, Houghton, Mifflin, & Co. 259 p. 12°. $1.50.

CLARKE, T. C., and others. The American Railway: Its Construction, Development, Management, and Appliances. With an Introduction by Thomas M. Cooley. New York, Scribner. 456 p. 8°.

DABNEY, W. D. The Public Regulation of Railways. New York and London, Putnam. 281 p. 12°. $1.25.

DUNTON, L., *ed.* The World and its People. Book I. First Lessons. Book II. Glimpses of the World. New York, Boston, and Chicago, Silver, Burdett, & Co. 319 p. 12°. 36 cents each.

GRINNELL, G. B. Pawnee Hero Stories and Folk-Tales. New York, Forest and Stream Publ. Co. 417 p. 12°. $2.

HARRISON, J. T. On the Creation and Physical Structure of the Earth. London and New York, Longmans, Green. & Co. 189 p. 8°. $2.50.

HOLBERG, L. Niels Klim's Wallfahrt in die Unterwelt. Ed. by E. H. Babbitt. Boston, Heath. 63 p. 16°.

HUGO, V. Bug-Jargal. Ed. by James Boïelle. Boston, Heath. 226 p. 16°.

MACFARLANE, A. Elementary Mathematical Tables. Boston and London, Ginn. 105 p. 8°. 85 cents.

MILLS, E. J., and ROWAN, F. J. Fuel and its Applications [being Vol. I. of Chemical Technology, ed. by C. E. Groves and W. Thorp]. Philadelphia, Blakiston. 862 p. 8°. $7.50.

MORGAN, T. J. Studies in Pedagogy. Boston, Silver, Burdett, & Co. 355 p. 12°. $1.75.

— The Leonard Scott Publishing Company write us they are still publishing the *American Naturalist* in its serial order, notwithstanding the announcements or statements of other parties.

— The eighth annual series (1890) of "Johns Hopkins University Studies in History and Politics," edited by Herbert B. Adams, will be published in twelve monthly numbers, averaging fifty pages each, and will be devoted to history, politics, and education. Among the papers that may be expected are "The Beginnings of American Nationality: The Constitutional Relations between the Continental Congress and the Colonies and States," by Albion W. Small, president of Colby University; "Development of Municipal Unity in the Lombard Communes," by William Klapp Williams; "Local Government in Wisconsin," by David E. Spencer; "The Study of History in France, Germany, Belgium, and Holland," by Professor Paul Frédéricq of the University of Ghent, translated by Henrietta Leonard; "Spanish Colonization in the Southwest," by Frank W. Blackmar, professor of history and sociology in the University of Kansas; "Seminary Notes on Recent Historical Literature," by H. B. Adams, J. M. Vincent, W. B. Scaife, and others; "Higher Education of the People: A Series of Social and Educational Studies," by Herbert B. Adams of Johns Hopkins University; "Notes on the Government and Administration of the United States," by W. W. Willoughby and W. F. Willoughby. Other papers will be announced from time to time. Seven series of the "University Studies" are now complete. The publication of a series of notes supplementary to the "Johns Hopkins University Studies in Historical and Political Science" was begun in January, 1889. The following have thus far been issued: "Municipal Government in England," by Dr. Albert Shaw of Minneapolis; "Social Work in Australia and London," by Mr. William Grey of London; "Encouragement of Higher Education," by Professor Herbert B. Adams; "The Problem of City Government," by Hon. Seth Low of Brooklyn; "The Libraries of Baltimore," by Mr. P. R. Uhler of the Peabody Institute; "Work among the Working-women in Baltimore," by Professor H. B. Adams; "Charities: The Relation of the State, the City, and the Individual to Modern Philanthropic Work," by A. G. Warner; "Law and History," by Dr. Walter B. Scaife. These "Notes" are sent without charge to regular subscribers to the "Studies."

## LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

*The editor will be glad to publish any queries consonant with the character of the journal.*

*On request, twenty copies of the number containing his communication will be furnished free to any correspondent.*

### The Various Discoveries of Lake Mistassini.

MY attention has been called to a communication of Mr. Jacques W. Redway in *Science* of Nov. 8, on the various discoveries of Lake Mistassini. I wish to correct a few misleading statements in it about the work of the Geological Survey of Canada. From Mr. Redway's letter it would appear that the Geological Survey was accountable for the various startling reports as to the immense size of the lake which have appeared from time to time during the past few years. This is not the case, as the only official reports on that region are those of Messrs. Richardson and McOuat in 1870 and 1871, and that of the writer in 1885. Mr. Bignall, who is credited by Mr. Redway with the survey of the lake, was employed by the Geological Survey and the Crown Lands Department of Quebec to make a complete survey of the lake in 1884, but, owing to certain reasons, was recalled before he had made any surveys on Lake Mistassini; and the work commenced by Messrs. Richardson and McOuat was continued and finished by myself. From the report of that survey, it may be seen that Mistassini is only one hundred miles long, with an average breadth of twelve miles.

Mr. Bignall and his sons are accountable for many of the stories as to the great size of the lake; but as they did not go around the lake, and have only Indian hearsay evidence for their statements, they may be taken for what they are worth against actual measurements.

It is a well-known fact that persons unaccustomed to the proper estimation of distances are liable to enlarge the portions traversed by them on great bodies of water, and to make the unknown parts often too small, thus greatly distorting the appearance of such lakes. These causes, along with those mentioned by Mr. Redway, would tend to throw Père Laure's map all out of proportion, and a more natural explanation of it can be given by taking these facts into account.

The lake was entered at the head of the south-east bay by the ordinary route from the Saguenay, as shown by the "Abanel portage," and the small southern portion of the bay enlarged and called "Lac Dauphin." "Lac des Père Abanel" extends as far as the narrows at the Hudson Bay Post; and "Jean Bay," from the Hudson Bay Post to the Big Narrows (Le grand percé). The point marked "Ancien Etablissement" is the point between the south-east and south-west bays, where the Indians still congregate in summer, to live on the fish which are there taken in great quantities.

The remainder and greater part of the lake is represented by that portion called "Lac des Mistassins," which, being unexplored, is made relatively much too small. By this interpretation of Père Laure's map we are not obliged to swing it 30°, dry up Lac Dauphin, and change the relative labels of different parts, to make it correspond with the modern map. Experience in the archæan region to the north of the St. Lawrence shows that the differences of level between the high and low lands there have reached almost a minimum, and consequently the denuding action of the rivers is very small.

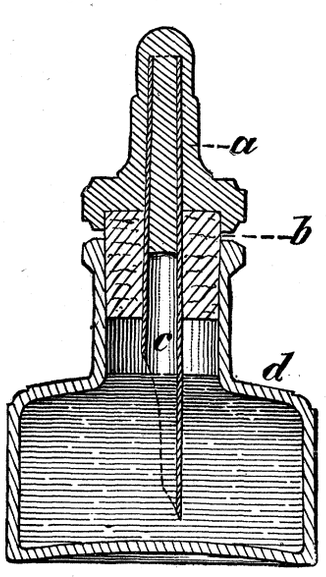
A. P. LOW.

Ottawa, Nov. 12.

## INDUSTRIAL NOTES.

### Liquid Drawing-Ink.

DRAUGHTSMEN, map-makers, surveyors, and others who frequently or occasionally use drawing-instruments, will be interested in a new drawing-ink now being put on the market by G. S. Woolman, dealer in mathematical and drawing instruments on Nassau Street, this city. This ink is a liquid, and does not become thick or gelatinous, like some inks heretofore introduced; neither does it injure the instruments. It is said to be the only perfect substitute yet found for the solid stick ink, which it is extensively displacing, especially in large establishments in which a great deal of work is done. It is put up, ready for immediate use, in special bottles, with combined stopper and pen-filler, a section of which is shown in the




accompanying cut. There are two kinds of the ink made, — a general drawing-ink, for tints, tracings, photo-drawing, fine line work, etc.; and a waterproof ink, which is insoluble when dry. The latter is intended for work which has to stand handling, moisture, or color-washes.

## Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

Morris's "British Butterflies," Morris's "Nests and Eggs of British Birds," Bree's "Birds of Europe" (all colored plates), and other natural history, in exchange for Shakesperiana; either books, pamphlets, engravings, or cuttings. — J. D. Barnett, Box 735, Stratford, Canada.

I have *Anodonta opalina* (Weatherby), and many other species of shells from the noted Koshkonong Lake and vicinity, also from Western New York, and fossils from the Marcellus shale of New York, which I would be glad to exchange for specimens of scientific value of any kind. I would also like to correspond with persons interested in the collection, sale, or exchange of Indian relics.— D. E. Willard, Albion Academy, Albion, Wis.

Will exchange "Princeton Review" for 1883, Hugh Miller's works on geology and other scientific works, for back numbers of "The Auk," "American Naturalist," or other scientific periodicals or books. Write. — J. M. Keck, Chardon, Ohio.

"I wish to exchange *Lepidoptera* with parties in the eastern and southern states. I will send western species for those found in other localities."— P. C. Truman, Volga, Brookings Co., Dakota.

Shells and curiosities for marine shells, curiosities or minerals address W. F. Lerch, No. 308 East Fourth St., Davenport, Iowa.

A collection of fifty unclassified shells for the best offer in bird skins; also skins of California birds for those of birds of other localities. Address Th. E. Slevin, 2413 Sacramento St., San Francisco, Cal.

I have forty varieties of birds' eggs, side blown, first class, in sets, with full data, which I will exchange for books, scientific journals, shells, and curios. Write me, stating what you have to offer. — Dr. W. S. STRODE, Bernadotte, Fulton County, Ill.

I want to correspond and exchange with a collector of beetles in Texas or Florida. — Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited. — E. E. BOGUE, Orwell, Ashta. County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for $2.50. Send post-office order to Charles H. Sternberg (author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

Any one who has a botanical box in good condition wil please write. I will offer about 30 specimens in exchange. — C. B. Haskell, Box 826, Kennebunk, Me.

Lead, zinc, mundic, and calcite. — Lulu Hay, secretary Chapter 350, Carthage, Mo.

Drawings from nature — animals, birds, insects, and plants — to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc. — Alda M. Sharp, Gladbrook, Io.

A few first-class mounted birds, for first-class birds' eggs of any kind in sets. — J. P. Babbitt, secretary Chapter 755, 10 Hodges Avenue, Taunton, Mass.

California onyx, for minerals and coins not in my collection. — W. C. Thompson, 612 East 141st Street, New York, N.Y.

## CALENDAR OF SOCIETIES.

### Boston Society of Natural History.

Nov. 20. — S. H. Scudder, Distribution of Insects in the Rocky Mountain Tertiaries, and the Discovery of New Localities for collecting Fossils of this Group; W. M. Davis, Geographic Development of Northern New Jersey.